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INSTALLATION RESTORATION PRO

GULFPORT FIELD TRAINING SITE
MISSISSIPPI AIR NATIONAL GUARD
GULFPORT-BILOXI REGIONAL AIRPORT
GULFPORT, MISSISSIPPI

SITE INVESTIGATION FINAL REPORT
VOLUME ONE

AIR NATIONAL GUARD

HAZWRAP
Oak Ridge, Tennessee 37831
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

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Site Investigation Report, Volume: 1.
A Site Investigation was performed at three sites at the Combat Readiness Training Center, Gufport-Bolixi. The three sites investigated are the: Former Fire Training Area (Site 1), the Former JP-4 Bulk Storage Area, Mill Road (Site 2), and the Motor Pool Above-Ground Diesel Fuel Storage Tank Area (Site 3).

The findings of this investigation recommended further investigation at the Fire Training Area and the JP-4 Bulk Storage Tank. At Site 3 the levels of contamination did not represent a risk to human health or the environment; therefore, no further action was recommended.

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AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM
SITE INVESTIGATION REPORT

GULFPORT FIELD TRAINING SITE
MISSISSIPPI AIR NATIONAL GUARD
GULFPORT-BILOXI REGIONAL AIRPORT
GULFPORT, MISSISSIPPI

Prepared for:

AIR NATIONAL GUARD READINESS CENTER
ANDREWS AIR FORCE BASE
MARYLAND

Submitted by:

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the: U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. DE-AC05-840R21400

Prepared by:

CH2M HILL SOUTHEAST, INC.

December 1992

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LIST OF ACRONYMS AND ABBREVIATIONS

ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ASTM	American Society for Testing and Materials
ATV	All-Terrain Vehicle
AVGAS	Aviation Gasoline
B	Boring
Base	Gulfport Field Training Site
BFB	Bromofluorobenzene
bgs	Below Ground Surface
Benzene EQ	Benzene Equivalent
BKGD	Background
BMDL	Below Method Detection Limit
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
BTR	CH2M HILL Baton Rouge, Louisiana, Office
Ca	Calcium
CCB	Continuing Calibration Blank
Cl	Chlorine
CLP	Contract Laboratory Program
CO_3	Sulfate
Corr. Coef.	Correlative Coefficient
CRDL	Contract Required Detection Limit
CSL	Close Support Laboratory
DCE	Dichloroethene
DD	Decision Document
°C	Degrees Celcius
°F	Degrees Fahrenheit
DFTPP	Decafluorotriphenylphosphine
DOD	Department of Defense
DOE	Department of Energy
DQO	Data Quality Objectives
DUP	Duplicate
EDB	Ethylene Dibromide
EDI	Estimated Daily Intake
EPA	Environmental Protection Agency
ER	Equipment Rinsate Blank
F	Fluoride
FB	Field Blank
Fe	Iron
FID	Flame Ionizing Detector
FFS	Focused Feasibility Study
FFS/RM	Focused Feasibility Study/Remedial Measure
FS	Feasibility Study

LIST OF ACRONYMS AND ABBREVIATIONS
(Cont'd)

ft	Feet
ft msl	Feet, Mean Sea Level
FTA	Fire Training Area
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GNV	CH2M HILL Gainesville, Florida, Office
GPS	Groundwater Probe Survey
HAZWRAP	Hazardous Waste Remedial Actions Program
HCO_3	Bicarbonate
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
ID	Identification
ID	Inner Diameter
IDL	Instrument Detection Limit
IRP	Installation Restoration Program
K	Potassium
kg	Kilogram
L	Liter
LCS	Laboratory Control Sample
LL	Liquid Limit
MCL	Maximum Contaminant Level
Mg	Magnesium
μg/kg	Micrograms Per Kilogram
μg/L	Micrograms Per Liter
μmhos	Micromhos
MDEQ	Mississippi Department of Environmental Quality
MDL	Method Detection Limit
mg	Milligram
Mg	Magnesium
mgd	Million Gallons Per Day
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
MGM	CH2M HILL Montgomery, Alabama, Office
MISS ANG	Mississippi Air National Guard
mL	Milliliter
MOGAS	Motor Vehicle Gasoline
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
MW	Monitoring Well
Na	Sodium

LIST OF ACRONYMS AND ABBREVIATIONS
(Cont'd)

NIOSH	National Institute for Occupational Safety and Health
NO_3	Nitrate
NOEL	No Observed Effects Level
OVA	Organic Vapor Analyzer
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PB	Preparation Blank
PCE	Tetrachloroethane
PCF	Pounds Per Cubic Foot
PEL	Permissible Exposure Level
%R	Percent Recovery
PI	Plasticity Index
POL	Petroleum, Oils, and Lubricants
ppb	Parts Per Billion
PPE	Personal Protective Equipment
PPT	Parts Per Thousand
PRE	Preliminary Risk Evaluation
Prgm	Program
psig	Pounds Per Square Inch Gauge
PVC	Polyvinyl Chloride
PZ	Piezometer
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RM	Remedial Measure
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SD	Sediment
sec	Second
SI	Site Investigation
SiO_2	Silica
SO_4	Chloride
SOW	Statement of Work
SVOC	Semivolatile Organic Compound
SW	Surface Water

LIST OF ACRONYMS AND ABBREVIATIONS
(Cont'd)

Target	Target Environmental Services, Inc.
TB	Travel Blank
TCE	Trichloroethene
TCL	Target Compound List
Temp	Temperature
TLV	Threshold Limit Value
TOC	Top of Well Casing
UHP	Ultra High Purity
UPC	Ultra Pure Carrier
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
WDC	CH2M HILL Reston, Virginia, Office

EXECUTIVE SUMMARY

The Air National Guard Readiness Center (ANGRC) has initiated the Installation Restoration Program (IRP) in response to the policies of the Department of Defense (DOD). The IRP has been developed as a phased program for identifying and addressing environmental contamination caused by past practices at Air National Guard (ANG) installations. The overall objective of the ANG IRP is to identify the potential environmental problem sites at all ANG installations and to provide timely remediation as required to protect public health and the environment from confirmed and quantified contamination associated with past hazardous waste disposal practices and possible spill sites.

The Site Investigation (SI) at the Gulfport Field Training Site (the Base), Mississippi ANG, Gulfport-Biloxi Regional Airport, Gulfport, Mississippi, was conducted according to the Sampling and Analysis Plan (SAP) dated October 1990. The following were the primary objectives of the SI at the Gulfport Field Training Site:

- Evaluate the presence of environmental contamination at the three sites identified in the Preliminary Assessment (PA) dated November 1988

- Conduct limited quantification of the extent of contamination, if detected

- Evaluate the potential risks the contamination posed to human health and the environment

The Preliminary Risk Evaluation (PRE) is a qualitative means of estimating potential risks. The objective of the PRE was to qualitatively estimate risks to human and environmental receptors from chemical substances identified during SI field activities. Based on the analysis of the data collected during the SI and the findings of the PRE, recommendations were made on what additional activities were needed, if any, to further evaluate or remediate the sites of concern. The following activities were evaluated:

- Risk assessment
- Decision documents (DDs) for no further action
- Focused feasibility study and remedial measure (FFS/RM)
- Remedial investigation/feasibility study (RI/FS)

The three sites identified in the PA included:

- Site 1: Fire Training Area (FTA)
- Site 2: JP-4 Bulk Storage Area, Mill Road

A sequenced investigation approach was used for the SI. During the initial or screening stage, activities included evaluating aerial photography, soil borings, hand sampling methods and groundwater probe surveys (GPS) to establish the locations of potential contaminant source areas at three sites. Also, piezometers were installed to estimate groundwater flow direction. Soil and water samples were analyzed in an onsite Close Support Laboratory (CSL) using gas chromatography (GC). Confirmatory and optional activities included collecting and analyzing soil samples from borings to characterize contaminant source areas further, and installing and sampling monitoring wells to evaluate groundwater quality.

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Background

A background boring was drilled at each of the three sites in areas expected to be unaffected by past waste disposal practices. Soil samples were collected from each boring and submitted to the CSL for Level B analysis. One soil sample from each boring was submitted to the analytical laboratory for Level C analyses. Each of these three borings was completed as a monitoring well. Groundwater samples were collected and submitted to the CSL for Level B analysis and to the analytical laboratory for Level C analyses.

Arsenic, cadmium, chromium, and lead were detected in the background soil samples. Lead was detected in all three samples at up to 36.8 milligrams per kilogram (mg/kg).

Cadmium, chromium, and lead were detected in unfiltered samples and are attributed to suspended solids in the samples. Lead was the only metal detected in the filtered samples at concentrations up to micrograms per liter (5 μg/L). Several organic compounds including benzene, carbon disulfide, methylene chloride, and toluene were detected in the background groundwater samples.

Site 1: FTA

Site 1 was used by the Base for fire training exercises from 1972 (suspected use since 1954) to 1988, when it was abandoned. The site is located on leased base property separate from the main compound and due west of the Gulfport-Biloxi Regional Airport Runway 13-31, and near Taxiway I on land that is leased by the Base from the airport. The FTA consists of an open, unlined pit with standing water that is up to 18 inches deep and contains the charred frame of an airplane. A drainage ditch is located within 25 feet of the FTA and overflows into a marshy area to the west. Three borings, three piezometers, three downgradient monitoring wells, and one background monitoring well were drilled and sampled during the field effort. Additionally, three surface water and six paired (2 depths at 3 locations) sediment samples were collected from the nearby drainage ditch.

Boring logs at Site 1 show that the surficial sediments consist of humic soils overlying silty to clayey sand. Water levels in the sand are 2 to 3 feet below land surface. Groundwater flow in the surficial aquifer is to the west and northwest at about 40 feet per year. Several shallow domestic water supply wells were identified in the residential subdivision located downgradient of Site 1.

Soil borings were drilled to depths of 6 feet and samples were collected at 0 to 2, 2 to 4, and 4 to 6 feet. Target organic compounds, including polynucleararomatic hydrocarbons (PAHs), ethylbenzene, and total xylenes, were detected in the soils at all depths, with the greatest concentrations indicated in the 0 to 2 foot depth interval. The greatest concentrations of benzene were found in the 2 to 4 foot depth interval. Three target organic compounds, benzene, toluene, and total xylenes, were detected in the groundwater at the FTA. These compounds are indicative of residual fuel contamination.

The concentration of benzene (up to 470 μg/L) exceeded the 1×10^{-4} cancer risk range and the maximum contaminant level (MCL) of 5 μg/L. Carbon disulfide (60 μg/L) exceeded the concentration that yields a hazard quotient of 1 in one duplicate surface water sample from one sampling round. Cadmium (6.4 μg/L) slightly exceeded the MCL of 5 μg/L but was within the range of background concentrations measured at the Base. Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel or future residents to the groundwater at Site 1 might present a health risk.

All organic chemicals of concern were measured in soil at concentrations below the concentrations that yield a cancer risk of 1×10^{-6} or a hazard quotient of 1. Cadmium, chromium, and silver were detected below the concentration that yields a hazard quotient of 1. A risk-based concentration is not available for lead, but the concentration measured at Site 1 is within the range of background concentrations measured. Therefore, based on a comparison of the concentrations measured (Section 3) to risk-based concentrations (Table 4.4 and 4.5), exposure of Base personnel or future residents to the soils at Site 1 is not expected to present a significant health risk.

Concentrations of four metals (cadmium, chromium, lead, and silver) in either surface water or groundwater exceeded the calculated water quality criteria. Sensitive aquatic species (ecological receptors) exposed to these waters could be adversely affected by these waters.

The PRE concluded that the levels of contamination detected in the surface water and groundwater may pose a risk to human health and the environment. Therefore, it is recommended that additional IRP activities be performed at Site 1. The need for remediation at Site 1 will be decided during a later stage of the IRP.

Site 2: JP-4 Bulk Storage Area, Mill Road

Site 2 was used for the storage of aviation gas (AVGAS) from 1943 to 1974 and JP-4 fuel from 1973 to 1989 in above-ground storage tanks. The facility is located on leased property between Bernard Bayou and Mill Road and housed two 25,000-gallon above-ground AVGAS tanks (removed) and one 440,000-gallon JP-4 above-ground tank (existing). About one-third of the original tank farm has been returned to the lease holder, therefore, it is no longer under the control of the ANG. The remaining property is fenced and access is restricted. Twelve soil borings, five piezometers, six monitoring wells and one background monitoring well were drilled and sampled during the field effort.

Boring logs from Site 2 showed that the surficial materials are primarily sand to at least 30 feet below land surface. Water levels in the sand bed are close to land surface ranging from about 1 to 4 feet below land surface. Groundwater flow within the surficial aquifer is towards the bayou and flows at about 45 feet. Many supply wells were identified within a 1-mile radius of the site, however, most were greater than 100 feet deep.

Soil borings were drilled to depths of 6 feet and samples were collected at 2 to 4 and 4 to 6 feet. Target organic compounds, including PAHs, benzene, chloromethane, ethylbenzene, carbon disulfide, toluene, trichloroethene, and total xylenes, were detected in the subsurface soils at both depths, with the greatest concentrations indicated in the 2 to 4 foot depth interval. Five organic compounds (benzene, ethylbenzene, ethylene dibromide [EDB], toluene, and total xylenes) were detected in the groundwater at Site 2. These compounds are indicative of residual fuel contamination.

EDB (up to 0.65 μg/L) and benzene (up to 200 μg/L) were present at concentrations that exceed the 1×10^{-4} cancer risk level and the appropriate MCLs. Carbon disulfide (up to 180 μg/L) exceeded the concentration that yields a hazard quotient of 1 (30 μg/L). Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel or future residents to the groundwater at Site 2 might present a health risk.

The concentrations of all chemicals of concern except lead were within the 1×10^{-6} to 1×10^{-4} cancer risk range or below the concentration that yields a hazard quotient of 1. The concentration of lead was within the range of background concentrations. Therefore, based on a comparison of the concentrations measured to risk-based concentrations, exposure of Base personnel or future residents to the soils at Site 2 is not expected to present a significant health risk.

Concentrations of lead in groundwater (up to 51.1 μg/L) exceeded calculated water quality criteria for prevention of toxicity to aquatic organisms. Discharge of this water to surface water bodies could adversely affect sensitive aquatic species.

The results of the PRE indicated that the levels of contamination detected in the groundwater may pose a risk to human health and the environment. Therefore, it is recommended that additional activities be performed at Site 2.

Site 3: Motor Pool Above-Ground Diesel Fuel Storage Tank Area

Site 3 was used to store motor gas (MOGAS) from 1954 to 1981 and diesel fuel from 1981 to the present in a 5,000-gallon above-ground storage tank. The facility is located at the Base Motor Pool to the east of Building 68 where the above-ground tank is contained within an open, unlined berm. Three hand-auger soil borings, three piezometers, one downgradient monitoring well, and one background monitoring well were drilled and sampled during the field investigation.

Boring logs at Site 3 showed that the surficial materials consist of sand from 0 to about 18 feet below land surface. A clay bed was encountered from 18 to 22 feet below land surface, which was the deepest boring at the site. The water table occurs at about 3 feet below land surface. Groundwater flow is to the south at about 12 feet per year. Many water supply wells were identified within one mile of the site. The wells range from shallow (less than 100 feet deep) domestic water supply wells to deep (greater than 900 feet) public water supply wells.

Hand-auger soil borings were drilled to depths of 6 feet within the tank berm area and samples were collected at approximately 4 to 6 feet. Target organic compounds that are indicative of residual fuel contamination, including PAHs, chloromethane, ethylbenzene, and total xylenes, were detected in the soils.

Soluble cadmium (6.9 μg/L) slightly exceeded the MCL (5 μg/L) but was within the range of background concentrations. Therefore, based on a comparison of the concentrations measured (Section 3) to risk-based concentrations, exposure of Base personnel or future residents to the groundwater at Site 3 is not expected to present a significant health risk.

Naphthalene and 2-methylnaphthalene exceeded the concentration that yields a hazard quotient of 1 in samples collected 4 feet below ground surface at one sampling location. These organic compounds are not expected to persist for a significant length of time. Therefore, based on a comparison of the concentrations measured to risk-based concentrations (Table 4.4), exposure of Base personnel or future residents to the soils at Site 3 is not expected to present a significant health risk.

Concentrations of lead and cadmium in groundwater exceeded calculated water quality criteria for prevention of toxicity to aquatic organisms. Groundwater at this site does not readily discharge to surface water bodies. The lack of exposure potential plus the natural occurrence of these metals indicates that these waters do not pose a risk to ecological receptors above background conditions.

The results of the PRE indicate that the levels of contamination detected in the soil and groundwater do not pose a risk to human health and the environment. Therefore, it is recommended that a DD be prepared for no further action at this site.

1. INTRODUCTION

1.1 PURPOSE

The Air National Guard Readiness Center (ANGRC) has initiated the Installation Restoration Program (IRP) in response to the policies of the Department of Defense (DOD). The IRP has been developed as a phased program for identifying and addressing environmental contamination caused by past practices at Air National Guard (ANG) installations. As part of the IRP, the ANGRC entered into an interagency agreement with the Department of Energy (DOE), under which DOE will provide technical assistance for implementing this program. Martin Marietta Energy Systems, through its Hazardous Waste Remedial Actions Program (HAZWRAP), is responsible for managing this effort for the ANGRC under the interagency agreement.

A Site Investigation (SI) was conducted at the Gulfport Field Training Site (the Base), Mississippi ANG, Gulfport-Biloxi Regional Airport, Gulfport, Mississippi, according to the process presented in the Sampling and Analysis Plan (SAP) dated October 1990. This report describes the SI field sampling activities and results, and presents the subsequent conclusions and recommendations. The SI was designed to evaluate the presence of contamination that might threaten human health and the environment at the three sites identified in the Preliminary Assessment (PA) performed by Automated Sciences Group, Inc., of Oak Ridge, Tennessee, dated November 1988.

1.1.1 Objectives

The overall objective of the ANG IRP is to identify the potential environmental problem sites at all ANG installations and to provide timely remediation as required to protect public health and the environment from confirmed and quantified contamination associated with past hazardous waste disposal practices and possible spill sites at the Base.

The SI was broader in scope than the Environmental Protection Agency's (EPA's) standard site inspection. It involves an increase in the scope of the field investigations at each site to aid in compiling enough data to support decisions made during the SI regarding further activities at the installation. This concept contributes to a potential decrease in the need for extensive field investigations in a remedial investigation (RI), if required, and allows the RI to proceed more effectively and efficiently because it is based on more extensive preliminary data.

The SI was designed to meet the following objectives:

- Develop an understanding of the site hydrogeology in order to evaluate groundwater flow in the uppermost aquifer and qualitatively evaluate the relationship of the shallow aquifer to deeper aquifers

- Evaluate whether volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) were present in the soil or uppermost groundwater at Sites 1, 2, and 3

- Evaluate whether VOCs, SVOCs, and eight metals were present in background soil and groundwater

- Perform a preliminary risk evaluation (PRE) of the sites

- Develop conclusions and recommendations for future actions at each site

1.1.2 Approach and Work Tasks

A sequenced investigation approach was used for the SI. The purpose of the initial or screening stage was to use the SI sampling to identify contaminant source areas and to select monitoring well locations in the areas likely to detect groundwater contamination. Screening activities included review of historical aerial photography to identify potential source areas. A groundwater probe survey (GPS) was conducted at Site 2, the JP-4 Bulk Storage Area. Piezometers were installed to estimate groundwater flow direction before monitoring wells were constructed. Also, environmental samples from a variety of matrices including soil, groundwater (from piezometers), stream sediment, and surface water were analyzed in an onsite Close Support Laboratory (CSL). The screening results were used to implement the confirmatory and optional activities.

The primary objectives of the confirmatory activities were to evaluate the presence and concentration of target compounds. Confirmatory work included collecting soil and groundwater samples from soil borings and monitoring wells, respectively, and submitting them to the analytical laboratory for HAZWRAP Level C analysis.

Optional activities included the installation of additional borings and monitoring wells based on the CSL data and field observations. The objective of the optional activities was to fill potential data gaps identified during the confirmatory phase and to conduct limited quantification of the extent of contamination.

The data obtained from the above tasks were used to prepare the PRE. The following were objectives of the PRE:

- Evaluate public health risks posed by the sites, assuming no remedial action is taken

- Evaluate potential human health risks, assuming changes in future site usage, by considering risks associated with alternative future land uses

- Identify additional data needed to evaluate the risks and evaluate the completeness of possible exposure pathways

- Identify potential environmental receptors and evaluate risk from site contaminants qualitatively

Based on the analysis of data collected during the SI and the findings of the PRE, recommendations were made on what additional activities were needed, if any, to further evaluate or remediate the sites of concern. The following activities were evaluated:

- Risk assessment
- Decision documents (DDs) for no further action
- Remedial investigation/feasibility study (RI/FS)
- Focused feasibility study/remedial measure (FFS/RM)

1.2 REPORT ORGANIZATION

This report is organized into five sections. Section 1 includes introductory information such as the purpose, facility and project background, and general project objectives. Section 2 describes the field program implemented during the SI. Results of the field work are discussed in Section 3. The PRE is presented in Section 4. Section 5 outlines conclusions and recommendations for each site studied during the SI. The appendixes present detailed information about project activities such as the CSL results, Level C analytical results, results of the data review and validation process, boring logs, slug tests, and the 1-mile radius well inventory.

1.3 FACILITY BACKGROUND

The background information in this section is extracted primarily from the PA report (Automated Sciences Group, Inc., November 1988).

1.3.1 Facility Site Description

The Base is located at the Gulfport-Biloxi Regional Airport. Gulfport-Biloxi Regional Airport is located in south-central Harrison County, about 5 miles east of downtown Gulfport, Mississippi. The peacetime mission of the Base is to provide a complete training facility for ANG and other DOD flying units. Because the Base is a training site only, it has no permanently assigned aircraft. The Base and leased site properties occupy approximately 231 acres of land and support about 16,000 to 18,000 personnel in 30 to 45 units per year (1985-1986 record). On average, the Base is used 325 days per year with about 95 percent of this use being from visiting ANG units. The Base has been located at Gulfport-Biloxi Regional Airport since 1952 and has been used

for training purposes since 1954. The Base was previously used by the U.S. Army Air Corps during World War II. An area map of the Base is presented as Figure 1.1.

Both past and present Base operations have involved the use of potentially hazardous materials and the disposal of wastes. Materials known to have been disposed of or stored at the Base include waste oils, contaminated fuels, paint wastes, spent cleaners, acids, strippers, and solvents. Deployments by individual ANG units over the years have typically been for 2 weeks or less. During these deployments, aircraft operations consisted of servicing (refueling, arming, etc.) and field maintenance. Industrial waste generating operations (e.g., metal plating, aircraft washing, aircraft and ground equipment painting, and paint stripping) typically are performed at home bases and were not performed at the Base.

The Base maintains a fleet of vehicles for use by deployed units. Included are refuelers, general purpose vehicles, carry-alls, and buses. A large quantity of common aerospace ground equipment is maintained and prepositioned at the Base.

1.3.2 Site Descriptions

Each of the three IRP sites is described below and shown in photographs in Appendix A. The location of each site is shown in Figure 1.2.

1.3.2.1 Site 1: Fire Training Area (FTA)

Site 1 is located on leased base property separate from the main compound and due west of the Gulfport-Biloxi Airport Runway 13-31 and near Taxiway I on land that is leased by the Base from the airport. This site was used solely by the Base for fire training from about 1972 to June 1988, but may have been used since 1954. The training area is an unlined, open pit, slightly bermed, with a general depth of 12 to 18 inches to contain the flammable materials used during training. A drainage ditch flows within 25 feet of the FTA and drains into a marshy area to the west. The burn pit usually contains standing water that drains into this small stream. The charred frame of an airplane is located in the center of the pit. According to the PA, mostly JP-4 fuel was burned in the pit, although some spent solvents, waste oils, paint "slop" (excess paint and thinner from painting and cleanup), and other flammables also were burned.

Training generally was conducted once or twice a month with two to four burns per exercise. Using the rationale presented in the PA of 18 fire training days every year, that approximately 500 gallons of flammable liquids were used for each exercise, three times a day, it is estimated that 27,000 gallons per year were used. According to the PA, approximately 70 percent of the flammables released at the FTA probably were destroyed during the period the site was in use; an estimated 8,100 gallons per year may have remained either to evaporate or to percolate into the ground. Thus, a potential total of 130,000 gallons of waste fuels may have either evaporated or

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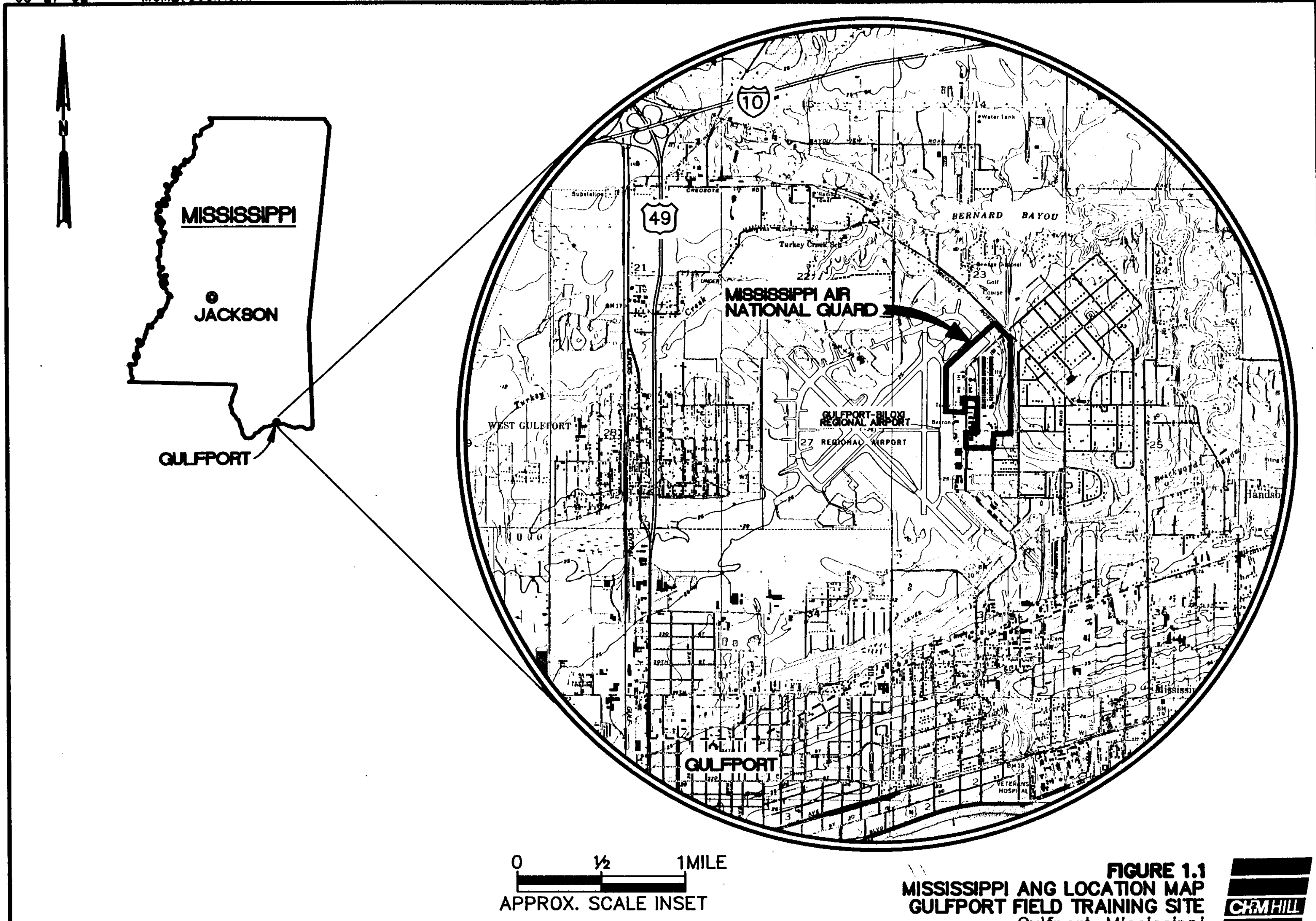

FIGURE 1.1
MISSISSIPPI ANG LOCATION MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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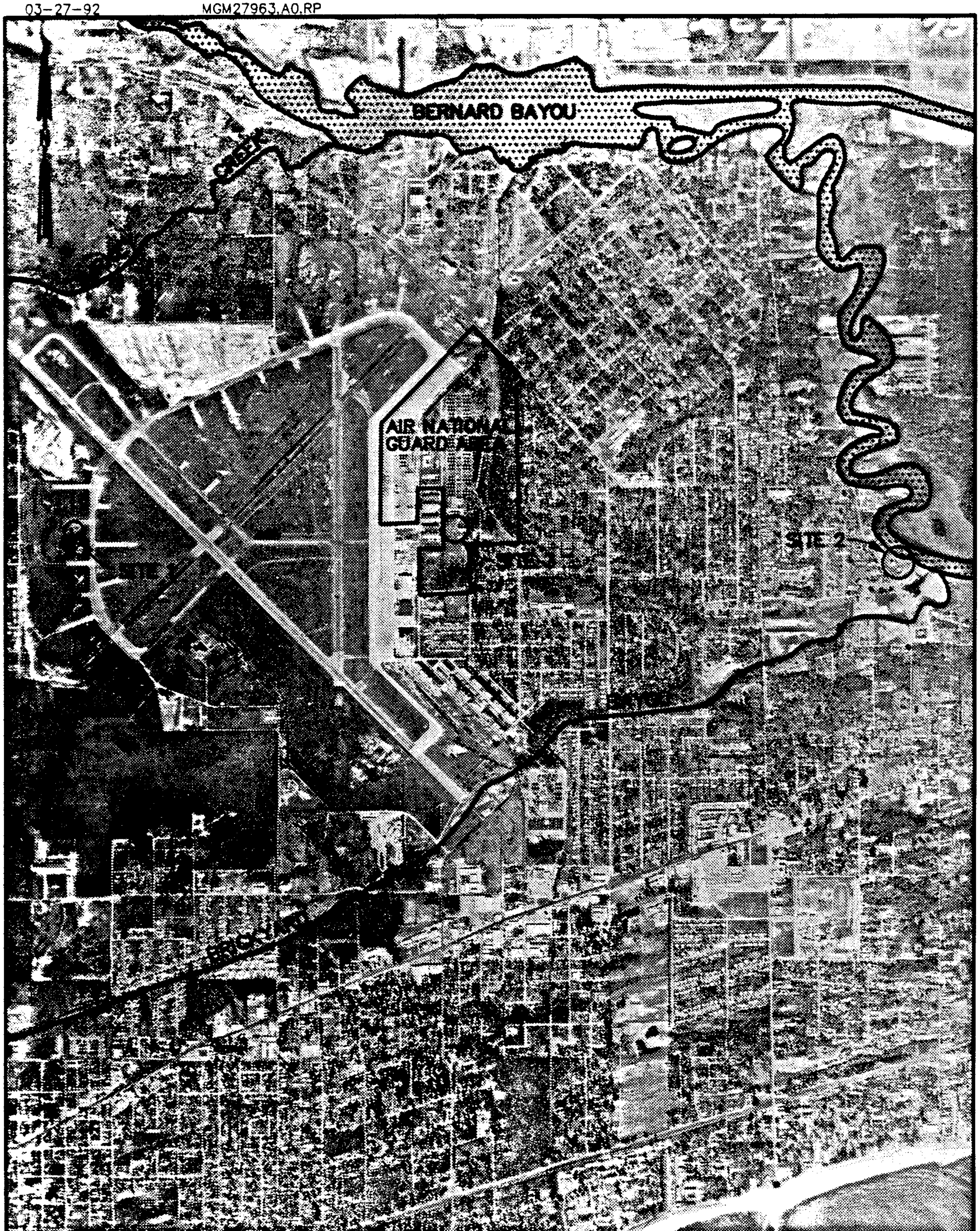

(SOURCE: MISS. ANG, 7/64)

0 1200 2400

SCALE IN FEET

FIGURE 1.2
SITE LOCATION MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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percolated into the ground during the 16-year period this FTA was known to be in use.

1.3.2.2 Site 2: JP-4 Bulk Storage Area, Mill Road

Site 2 is located about 1 mile east of the main area of the Base, on Mill Road near Bernard Bayou. Currently, one above-ground tank, constructed in 1973 with a capacity of about 440,000 gallons and used to supply JP-4 fuel, exists at the facility. This tank was abandoned in August 1989. The ANG plans to remove this tank and return the property to the original owner.

As reported in the PA, two above-ground storage tanks were built during World War II at the fuel facility. These were used to supply piston-engine aviation fuel 115/145 aviation gasoline (AVGAS) to the flightlines at the Base and to Keesler Air Force Base. Each of these tanks had an approximate capacity of 25,000 gallons. According to the PA, these fuel tanks were in use from 1943 until 1970 when the use of AVGAS at the Base was discontinued. These tanks were removed in 1973 and 1974, and the structural steel was hauled offsite. The Base reports that the tank bottom sludges from the demolished tanks were buried within the bermed areas and the bermed areas subsequently regraded.

Condensed moisture from all three tanks was drained daily according to the PA. The condensate typically was discarded directly into the soil in the immediate vicinity of the base of the tanks. An estimated ½ to 1 gallon of condensed moisture was discarded daily from each tank. At the maximum rate of release, an estimated 19,700 gallons of water contaminated with AVGAS may have been released within the bermed areas of the AVGAS storage tanks over the 27-year period that AVGAS was used at the Base. An estimated 5,500 gallons of water contaminated with JP-4 fuel also may have been released within the bermed area of the present JP-4 fuel storage tank during the 15 years that this tank was in use. If the condensed moisture was 98 percent water as assumed in the PA, an estimated 400 gallons of AVGAS and 110 gallons of JP-4 fuel may have infiltrated the soil at this site.

Additionally, the PA reports that a fuel spill of AVGAS occurred in the mid-1960s during a fuel transfer operation near the refueling island. An estimated 2,000 gallons of AVGAS were reportedly spilled. An estimated 95 percent of this spill either evaporated or was flushed to the storm drainage system according to the PA. The storm drainage system referred to in the PA report is assumed to be the roadside ditch (very slight depression) adjacent to the site.

The tanks were cleaned periodically to remove sludge that may have built up on the bottoms of the three tanks. The sludge from the tank cleaning operations typically was spread on the ground so that volatile components could evaporate. The residues were disposed of by shallow land burial within the bermed areas of the containment system.

The northern portion of the leased land that comprises the site was returned to the owner after demolition of the original two tanks. Subsequently this land was subdivided and sold as potential residential sites.

1.3.2.3 Site 3: Motor Pool Above-Ground Diesel Fuel Storage Tank Area

Site 3 is the 5,000-gallon above-ground diesel fuel storage tank (Facility No. 22) located within a 3-foot earthen bermed area to the east of Building 68, which has been in place since 1954. According to the PA, the tank was used for gasoline storage until 1981 when it was converted to diesel fuel storage. Two underground diesel and gasoline storage tanks are positioned immediately to the east, northeast of the site.

The PA reported an estimated 3,400 gallons of fuel (2,700 gallons of motor gasoline [MOGAS] and 700 gallons of diesel fuel) may have been released at this site during normal filling and discharging operations since 1954. Visible soil staining is present within and near the bermed containment area, indicating that minor fuel spills have occurred.

1.4 PREVIOUS IRP ACTIVITIES

The November 1988 PA records search at the Base consisted of an evaluation of historical Base records, interviews with Base employees, analysis of existing hydrogeologic and environmental data, and a field survey. Three sites at the Base were identified during the PA as potential past hazardous waste disposal sites that warrant further investigation.

The SI SAP was completed in October 1990. The SAP presents the objectives of the investigation, the approach and sampling rationale, scope of sampling activities, and detailed procedures. The document was reviewed by the Mississippi Department of Environmental Quality (MDEQ) and review comments were received in June 1990. The SAP was approved by MDEQ in August 1990.

1.5 REGIONAL INVESTIGATION AREA

1.5.1 Environmental Setting

The Base is located about 2 miles from the coast of the Mississippi Sound and the Gulf of Mexico. The land surrounding the Base consists of mostly residential areas, which are shown on Figure 1.3, the Land Use Map, in yellow. Located adjacent to the northeastern portion of airport property are water/wetland areas that are shown in blue. Adjacent to the airport property to the southwest and north of the water/wetland areas are areas of mixed forest/dense vegetation, which is shown in green. The industrial and commercial properties are shown in red and orange, respectively.

The climate of the Mississippi gulf coast includes long, humid summers with average daily high temperatures of 94 degrees Fahrenheit (°F). The winters are short and

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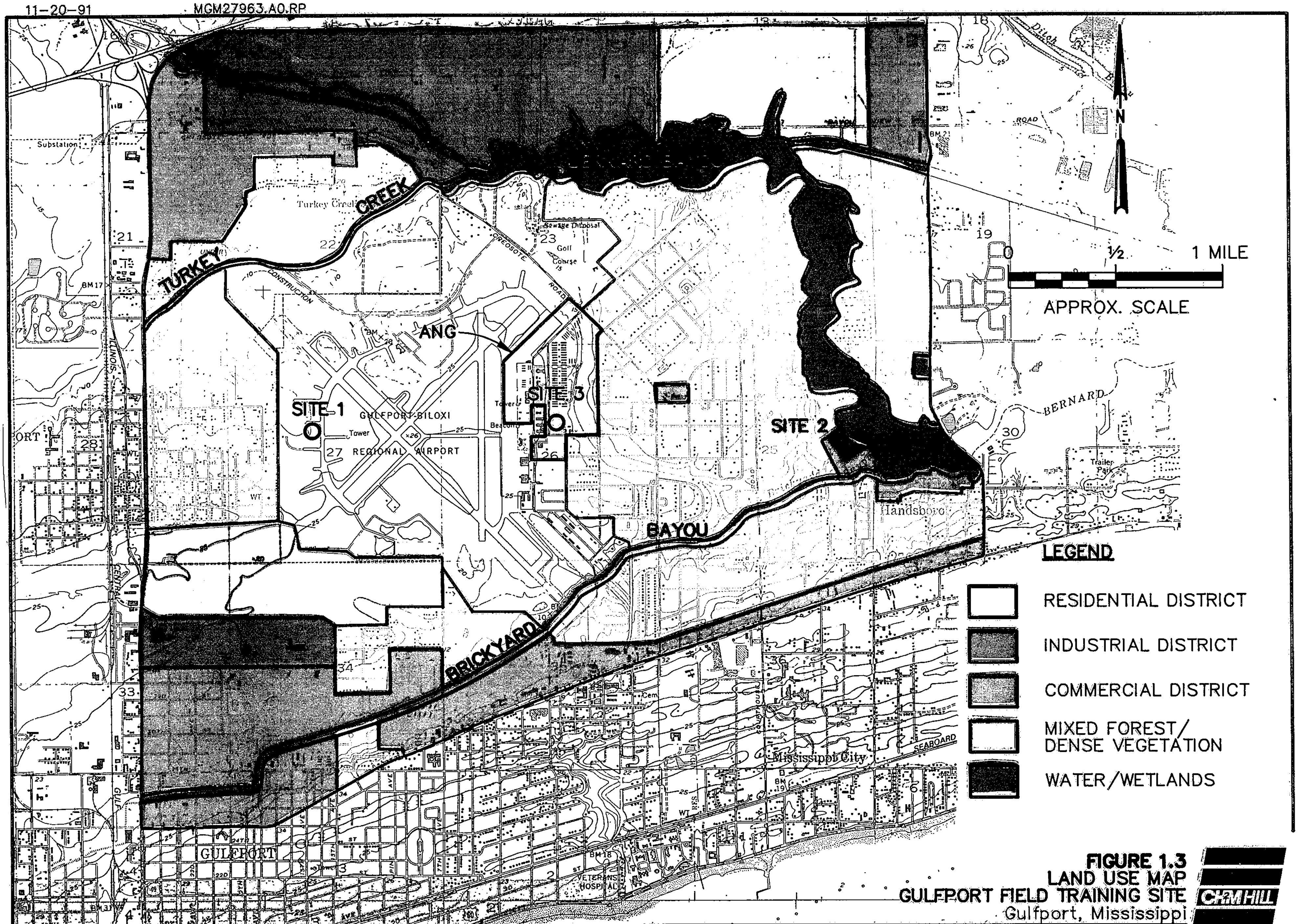

FIGURE 1.3
LAND USE MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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mild with rare cold waves that normally moderate in 1 or 2 days. The average annual temperature is 68°F.

Harrison County has an average annual rainfall of 62.5 inches and an annual net precipitation of about 15 inches. July is normally the wettest month, and October is the driest (Newcombe, *et al.,* 1968).

The Gulf Coastal area of Mississippi around Gulfport is drained principally by the Biloxi River. One tributary, Bernard Bayou, flows eastward and passes within a mile of the north boundary of the Base. An unnamed tributary and Turkey Creek join with Bernard Bayou just north of the airfield. Brickyard Bayou passes south of the airfield and joins Bernard Bayou about one mile east of the Base just south of Site 2.

According to the PA, the Base property does not lie in a floodplain associated with a 100-year flood. However, Site 2, located off-base on Mill Road, is located in the 100-year floodplain.

The City of Gulfport derives potable water from a well field that includes wells near the Base. These large diameter wells derive water from multiple deep aquifers. The fresh water aquifers in Harrison County can be found at depths of up to 2,500 feet near Gulfport. Most major supply wells in Gulfport tap the Graham Ferry and Pascagoula formations at depths of 900 to 1,200 feet. Fresh water intervals in these sand aquifers range in thickness from 10 to 270 feet with an average thickness of about 65 feet.

1.5.2 Regional Geology and Hydrogeology

The following section describes the regional hydrogeologic setting, beginning with a discussion of the geologic framework. A discussion of the regional aquifer systems is also included. A detailed discussion on the hydrogeology underlying the Base is included in Section 3.

1.5.2.1 Geologic Framework

The Base is located in the Atlantic Division Physiographic Province, which is further divided into sections based on differences in geology and topography. Gulfport and the vicinity, including the Base, lie within the Gulf-Atlantic Coastal Flats subdivision, which consists of gently rolling terrain with beach ridges between the Base and the coast.

The topography of the Base is relatively flat with an elevation of about 25 feet above sea level. The northern edges of the Base slope down toward Bernard Bayou, which is within 1 mile of the Base. The southern edge of the Base also slopes down toward Brickyard Bayou, which is just south of the Base, and continues to slope down to the Mississippi Sound.

Table 1.1
Regional Stratigraphic Column

Series	Formation	Thickness (feet)	Physical Characteristic	Hydrologic Properties
Pleistocene and Recent	Alluvium	0-35+	Chert and quartz gravels and sands grading up into sandy clays and silts. Much organic debris including sawdust near and in the tidal marshes.	Contains large undeveloped supplies especially attractive because of uniform low temperature throughout the year. The southernmost portions of the Pascagoula River alluvium are known to contain salty water, and the other estuaries are probably similar; consequently large developments should be located with care.
Pleistocene	Pamlico Sand	1-75	Mostly unconsolidated gray and tan sand; locally contains pebbles of quartz and chert and in former lagoonal areas. Much clay and silt.	Contains much water in the beach areas under water-table conditions and in contact with salt water. In many places the supply has been contaminated with sewage, but would be suitable for air conditioning if saltwater connection is considered.
	Low Terrace Deposit	0-20	Sand derived from beach deposits, locally sprinkled with pebbles of quartz and brown chert.	Insufficient thickness and areal extent to yield other than small shallow wells for domestic and stock consumption.
	High Terrace Deposit	0-100	Sand and gravel wherein quartz is more abundant and chert less abundant than in the older adjacent Citronelle formation; locally an iron-cemented conglomerate at the Base.	Small farm supplies are derived from the High Terrace deposits. The elevated position facilitates drainage through springs and effluent seepage, so that only the lower few feet are saturated.
	Citronelle	0-160	Brick-red sand and gravelly sand; the pebbles are mostly brown chert and milky quartz; generally cross-bedded, and in the lower part contain thin beds and pockets of gray clay and clayey gravel.	Numerous small farm supplies derived from a few feet of saturated sand and gravel in the lower part of the formation. Salt-water encroachment ruined a supply at Moss Point which probably came from a finger of the Citronelle gravel.
Pliocene and Pleistocene	Graham Ferry Formation	113-975	Silty clay and shale, sand, and gravelly sand and gravel in heterogeneous deltaic masses; various colors, generally dark; carbonaceous clay most abundant in the outcrops; marine fossil casts in the upper beds are common.	The most intensively developed formation, containing water under artesian pressure throughout the southern part of the area.
Miocene	Pascagoula Formation	800-1,300	Clay and shale, generally blue-green, silt, sandy shale, gray and green sand, gray silty clay, and dark sandy gravel containing numerous grains and pebbles of polished black chert; of estuarine or deltaic origin; identified for the most part by brackish water clam, Rangia johnsoni	About 40% of the water produced in the coastal area has come from artesian sources within the Pascagoula formation. The eastern part, Jackson and eastern Harrison Counties, contains some brackish water, the salt content increasing with depth and toward the east.
	Hattiesburg Formation	350-1,500	Gray-green and blue-green shale and clay, gray sand and silt, mostly carbonaceous and noncalcareous--of a more continental origin than overlying beds.	Undeveloped supplies along the crest of the Wiggins-Lucedale anticline in the northern part of the area. The remainder of the formation contains brackish or salt water.
	Catahoula Sandstone	300-560	Shale, sandy shale, sand, clay, silt, and gravelly sands containing black chert.	The uppermost Catahoula Sandstone contains fresh water on the crest of the Wiggins-Lucedale anticline, according to electrical logs of oil prospect wells. Undeveloped in the coastal area.

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Discussion of the stratigraphy in this report is limited to those sediments containing fresh water. The fresh water section in the vicinity of the Base consists of about 2,500 feet of Miocene, Pliocene, and Pleistocene sediments. Table 1.1 presents a stratigraphic column for the region and Figure 1.4 is a geologic map of Harrison and neighboring counties. Formations exposed in Harrison County include marine and nonmarine deposits and alluvium of the Pleistocene and Recent Series of the Quaternary System (Newcombe, *et al.*, 1968). Newcombe, *et al.* (1968) reports that the Miocene to Recent Series were deposited in deltaic and estuarine environments. The result of these depositional environments is a highly variable sequence of lenticular sand and clay beds. Throughout the 2,500-foot thick fresh water section there are no traceable sand or clay beds. Formation boundaries are mapped regionally by correlating predominantly sandy zones and fossil occurrences.

The Base is situated on the east flank of the Mississippi Embayment portion of the Gulf Coast Geosyncline. The Mississippi Embayment plunges to the south and is responsible for the regional dip as all strata are folded downward toward the axis. The regional dip ranges from 50 feet per mile in Stone County, the bordering county north of Harrison County, to 90 feet per mile at the coast (Newcombe, *et al.,* 1968). A cross-section of the regional geology is shown in Figure 1.5.

The following paragraphs describe the strata underlying the Base as reported by authors of the U. S. Geological Survey (USGS) and the Mississippi Bureau of Geology publications.

Pamlico Sand Formation. The Base rests on the Pamlico sand deposit, which is up to 75 feet thick and crops out throughout much of the coastal plain around Gulfport. The sand deposit overlies either the Citronelle formation, where present, or the Graham Ferry formation. The Pamlico sand consists mostly of unconsolidated gray and tan sand, locally containing pebbles of quartz and chert, with some clay and silt in former lagoonal areas.

Graham Ferry Formation. The Graham Ferry formation crops out in south Mississippi and dips toward the south-southwest. The outcrop area is a curved band that in southwest Harrison County extends within 1 mile of the Mississippi Sound. The formation overlies the Pascagoula formation and in turn is overlain by the Citronelle formation, where present, or the Pamlico sand. The formation consists of a heterogeneous deltaic mass of silty clay, shale, silty sand, sand, gravelly sand, and gravels.. The Graham Ferry formation ranges in thickness from 113 to 975 feet, with the thickest section being found beneath Gulfport.

Pascagoula Formation. The Pascagoula formation crops out in south Mississippi and dips toward the south-southwest. The outcrop area is a curved band that extends from near the Pearl River in west Mississippi to the Alabama state line. The formation overlies the Hattiesburg formation and in turn is overlain by the Graham Ferry formation. The formation consists of silty clay, shale, silt, sand, and sandy gravel

containing numerous grains and pebbles of polished chert of estuarine or deltaic origin. The formation ranges in thickness from 800 to 1,300 feet.

1.5.2.2 Groundwater Resources

The geologic units underlying the Base include several permeable beds that are capable of supplying significant quantities of water to wells. The regional aquifers include the Graham Ferry and Pascagoula aquifers. The Graham Ferry aquifer is present throughout the depth interval of about 113 to 975 feet, and the Pascagoula aquifer is present throughout the depth interval of about 800 to 1,300 feet. Minor aquifers occur within the Pamlico sand and alluvial deposits throughout the area. Callahan reported that in 1980, the Harrison, Hancock, and Jackson county area used 38.22 million gallons per day (mgd) of groundwater from the Graham Ferry aquifer and 11.52 mgd from the Pascagoula aquifer.

Pamlico Aquifer. The Pamlico aquifer is the uppermost aquifer underlying the Base, but is not considered to be a regional aquifer. The aquifer, used locally for irrigation and limited water supply, ranges in thickness from 0 to 75 feet and consists mostly of unconsolidated gray and tan sand, locally containing pebbles of quartz and chert.

Some clay and silt layers that formed in lagoonal areas are also present. The aquifer is unconfined (water table) and its base is formed by clay layers within the Pamlico sand formation and clay layers in the upper portion of the Graham Ferry formation.

The water table, which is the top of the Pamlico aquifer, occurs from 1 to 5 feet below land surface at the three IRP sites. Groundwater flow within the aquifer is generally towards the major surface water bodies where the groundwater discharges. Flow rates within the aquifer were estimated to be about 10 to 40 feet per year. Further discussion of Base-specific hydrogeology is provided in Section 3 in the discussion of each site.

Graham Ferry Aquifer. Graham Ferry is a regional aquifer and is used for domestic, industrial, and public water supply. The City of Gulfport operates a well field that has wells completed in the Graham Ferry aquifer for water supply to the airport and the Base. The aquifer consists of several beds of silty sand, sand, gravelly sand and gravel throughout the formation. Within the aquifer, individual bed thickness ranges from 10 to 270 feet, with an average thickness of 65 feet. The formation is confined from above and below by regional confining layers of clay within the Graham Ferry and Pascagoula formations.

Groundwater movement in the Graham Ferry aquifer is generally south as a result of recharge in outcrop areas to the north. The recharge areas of this aquifer are along the outcrop areas just north of the coast line. Recharge occurs by infiltration of precipitation through overlying sandy deposits as well as seepage between aquifers that have a sufficient head differential. Flow direction beneath the Base is modified by groundwater withdrawals in Gulfport and by local recharge. The effects of local

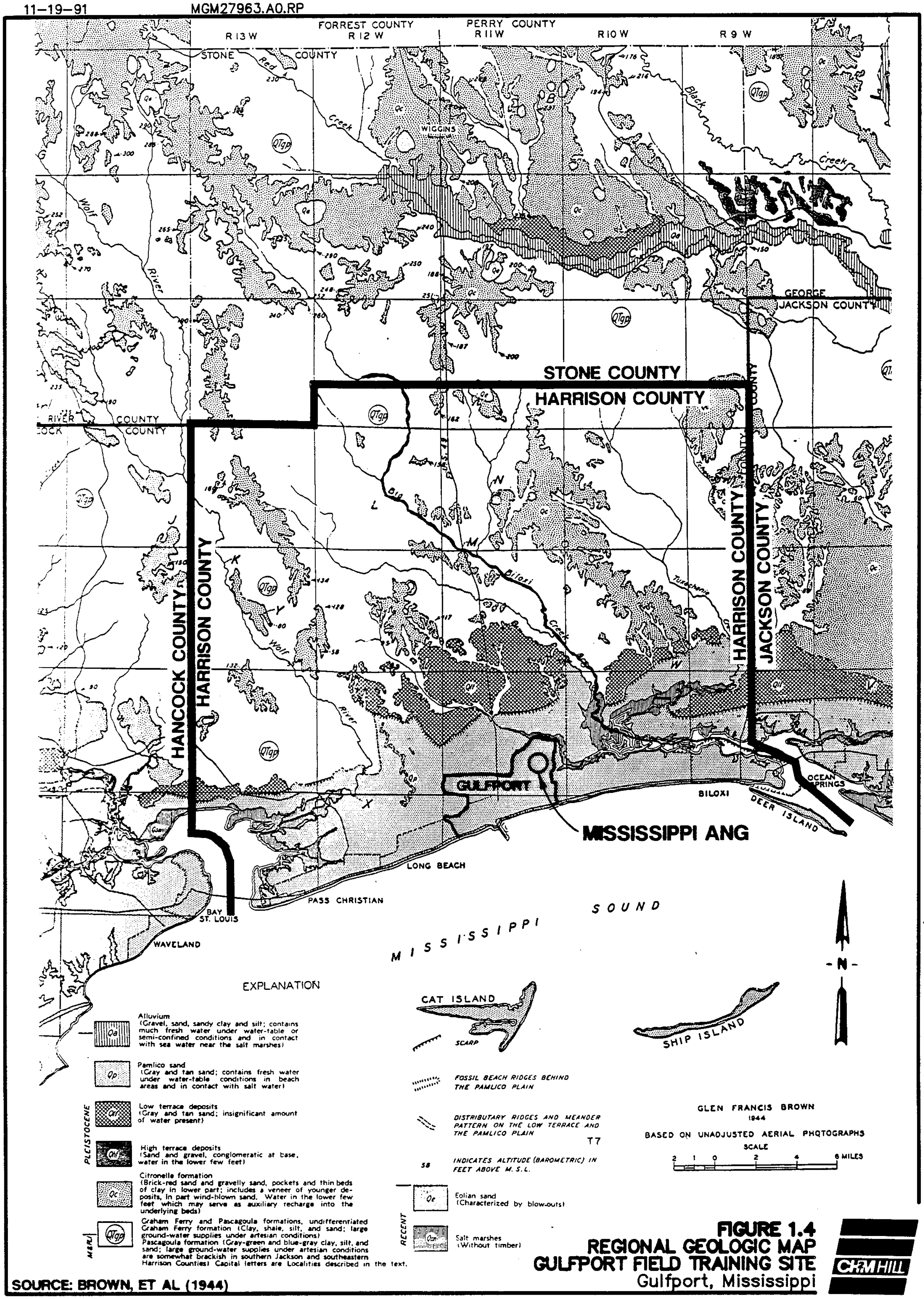

FIGURE 1.4
REGIONAL GEOLOGIC MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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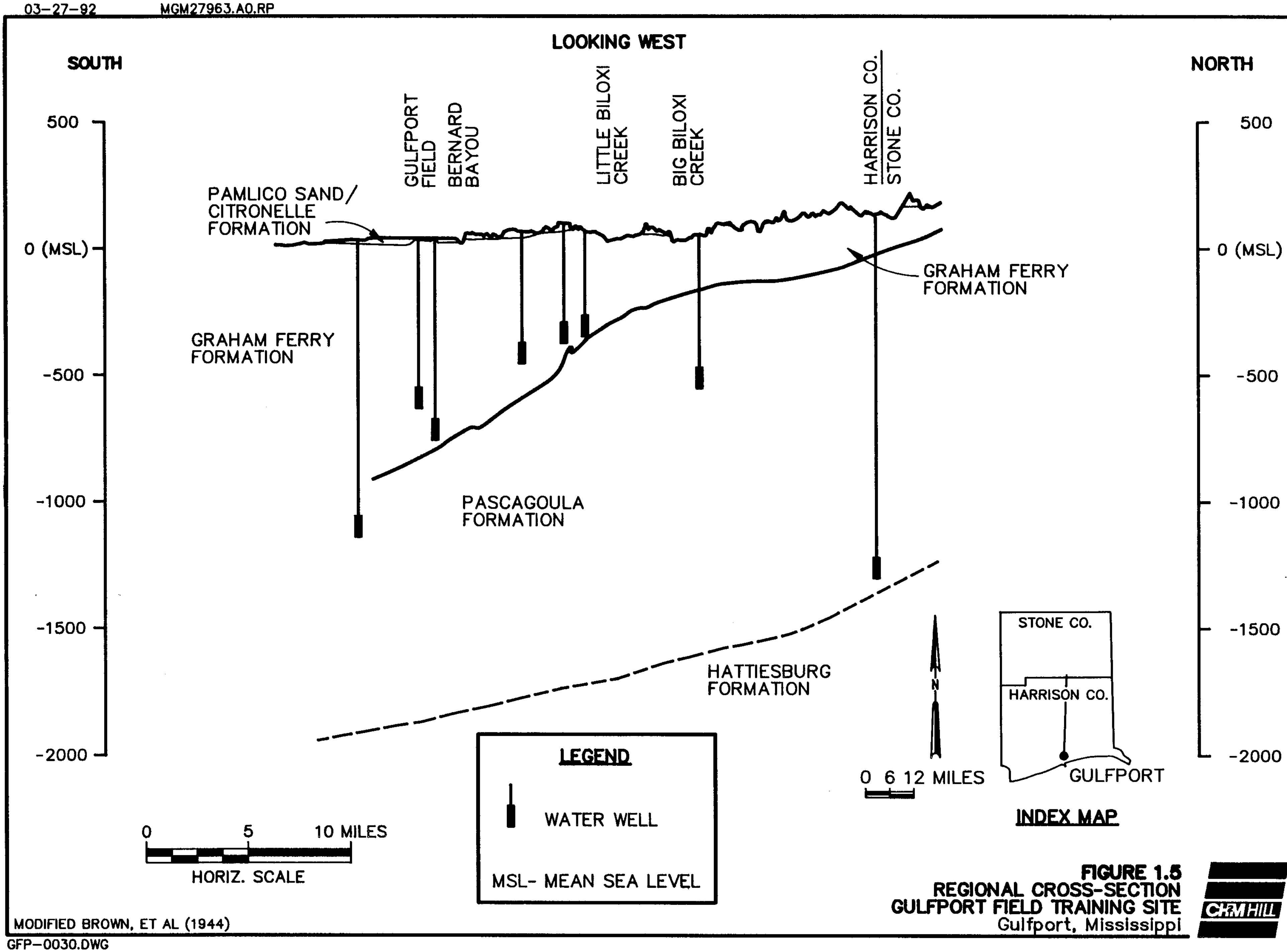

FIGURE 1.5
REGIONAL CROSS-SECTION
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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recharge and pumping may result in a complex potentiometric surface gradient and flow directions that deviate from the regional flow direction.

According to Newcombe (1968), transmissivity of the Graham Ferry aquifer, as determined by pump tests performed on two wells located near the Base, was 27,000 and 85,000 gallons per day per foot.

Pascagoula Aquifer. The Pascagoula is a regional aquifer and is used for domestic, industrial, and public water supply. The City of Gulfport operates a well field that has wells completed in the Pascagoula aquifer for water supply to the airport and the Base. The aquifer consists of several beds of sand and sandy gravel containing numerous grains and pebbles of polished chert. Within the aquifer, the individual bed thickness ranges from 10 to 270 feet, with an average thickness of 65 feet. The formation is confined from above and below by regional confining layers of clay within the Graham Ferry and Pascagoula formations.

1Groundwater movement in the Pascagoula aquifer is generally south as a result of recharge in outcrop areas to the north. The recharge areas of this aquifer are along the outcrop areas north of the coast line extending across south Mississippi. Recharge occurs by infiltration of precipitation through overlying sandy deposits as well as seepage between aquifers that have a sufficient head differential. Flow direction beneath the Base is modified by groundwater withdrawals in Gulfport and by local recharge. The effects of local recharge and pumping may result in a complex potentiometric surface gradient and flow directions that deviate from the regional flow direction.

According to Newcombe (1968), transmissivity of the Pascagoula aquifer, as determined by a pump test performed on a well located near the Base, was 96,000 gallons per day per foot.

1.5.3 Regional Groundwater Background Data

Table 1.2 summarizes the results of the analysis of groundwater samples from selected wells in the Graham Ferry and Pascagoula aquifers. These data are presented to illustrate the potable quality of groundwater from these aquifers.

A well inventory was conducted within a 1-mile radius of the three sites studied in the SI. The results of the inventory are summarized in Figure 1.6 and are detailed in Appendix B. The USGS in Jackson, Mississippi, maintains a database of wells in Mississippi. The database listed 329 operating or unused wells located in or near the survey area. The data base search area is larger than the 1-mile radius but probably does not include all wells present in the area.

Some, but not all, of the wells identified by the USGS were able to be field verified. The wells range in depth from 4 to 1,400 feet and tap the Pamlico, Graham Ferry, and Pascagoula aquifers. Table 1.3 shows a breakdown of well uses near the Base.

The largest number of wells in the area are used for domestic supply, which includes potable water supply and lawn and garden irrigation. Of the 233 wells identified for domestic use, 50 were reported to be less than 100 feet deep. Wells that are lessthan 100 feet deep either draw water directly from the uppermost aquifer or are expected to be hydraulically connected to the uppermost aquifer.

The depths of water wells in the area vary greatly as shown on Table 1.3, from less than 20 feet to 1,400 feet. Of the 329 wells in the area, 73 (22 percent) are less than 100 feet deep. The wells are shown on Figure 1.6.

At least one public water supply well is within the one-mile search radium of each of the three sites. The closest water supply well is about 1,300 feet from Site 3. There are public supply wells within 5,300 and 3,500 feet of Sites 1 and 2, respectively. None of the public supply wells draw water from the uppermost aquifer as indicated by well depth and well construction practices. During sustained pumping, it is likely that the sites are within the hydraulic radius of influence of the high capacity wells.

Table 1.2
Chemical Analyses of Water from Selected Wells
Gulfport Field Training Site, Gulfport, Mississippi

Parameters	**Graham Ferry Formation**			**Pascagoula Formation**	
Well Depth (ft)	825	229	668	1,199	1,242
Silica (SiO_2) mg/L	18	29	41	20	19
Total Iron (Fe) mg/L	--	0.38	0.16	0.11	0.09
Soluble Iron (Fe) mg/L	0.03	--	0.02	--	0.01
Calcium (Ca) mg/L	1.9	1.6	0.9	1.0	0.6
Magnesium (Mg) mg/L	0.8	0	0.5	0.6	0.7
Sodium (Na) mg/L	90	69	53	149	124
Potassium (K) mg/L	--	0.2	2.4	1.9	5.1
Bicarbonate (HCO_3) mg/L	176	173	125	342	270
Carbonate (CO_3) mg/L	24	0	0	9	20
Sulfate (SO_4) mg/L	11	7.8	9.1	6.2	8.5
Chloride (Cl) mg/L	5.5	3.8	5.2	18	6.8
Fluoride (F) mg/L	--	0.3	0	0.7	0.5
Nitrate (NO_3) mg/L	Trace	0.1	0.7	0.3	2.5
Dissolved Solids mg/L	238	197	174	375	317
Hardness as $CaCO_3$ (Calcium, Magnesium) mg/L	--	4	4	5	4
Specific Conductance (μmhos at 25°C)	--	290	219	610	500
pH	--	7.3	7.9	8.4	8.8

Source: Water for the Growing Needs of Harrison County, Mississippi, Newcombe, 1968.

Notes:
--: Parameters not analyzed.
mg/L: Milligrams per liter.
μmhos: Micromhos.

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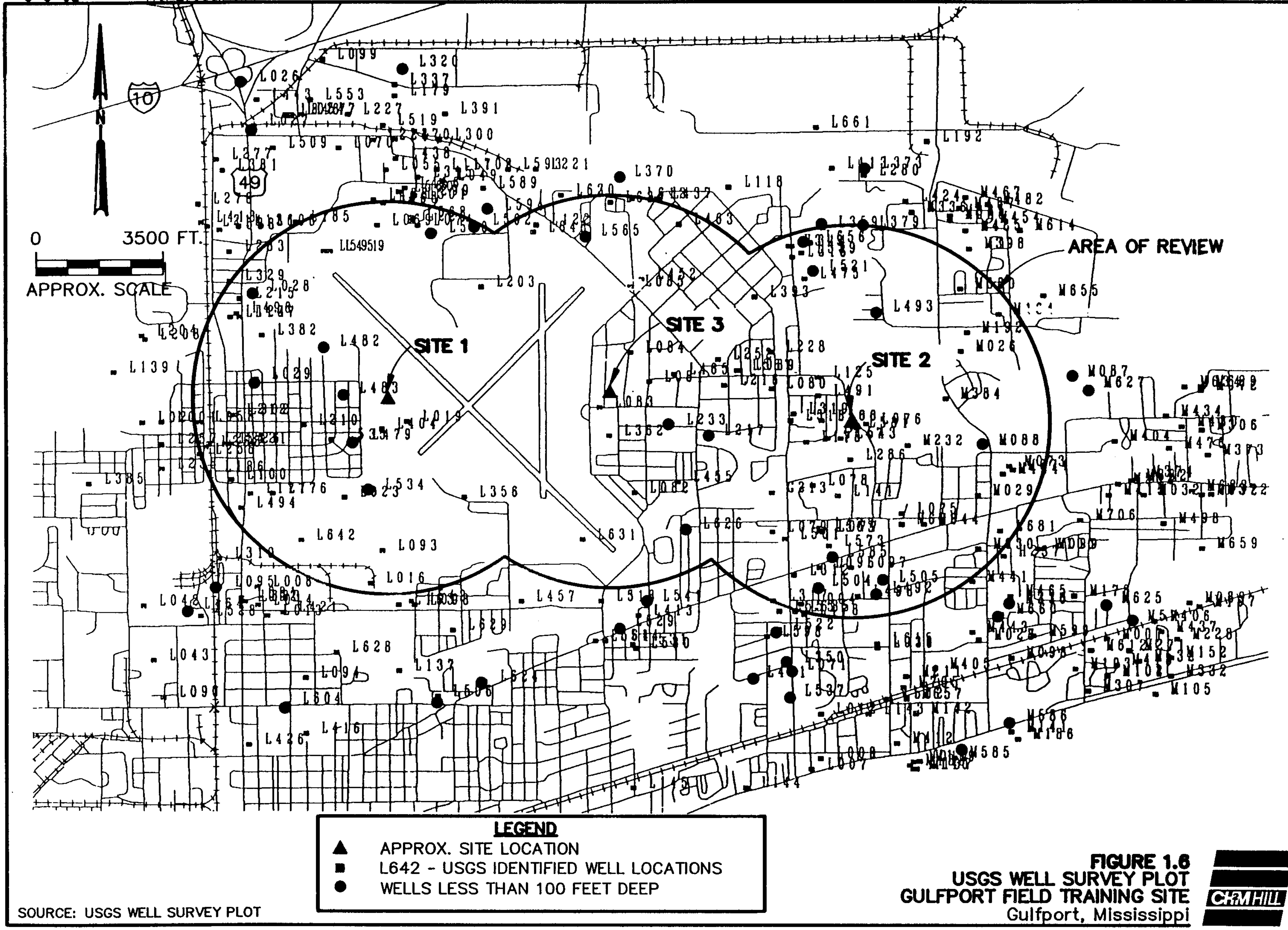

FIGURE 1.6
USGS WELL SURVEY PLOT
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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Table 1.3
Summary of Well Inventory Data from the USGS
Gulfport Field Training Site, Gulfport, Mississippi

Well Use	No. of Wells	Depth Range (ft bgs)	No. of Wells Less Than 100 ft Deep
Domestic	233	20-1,212	50
Unused	50	4-1,400	9
Industrial	20	30-1,180	8
Public	12	337-926	0
Other	11	16-855	6
Commercial	3	820-902	0
Total Number of Wells	329	4-1,400	73

Notes:
bgs: Below ground surface.
"Other" refers to miscellaneous uses including monitoring.

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2. FIELD PROGRAM

This section presents the Data Quality Objectives (DQO) and a description of field activities that occurred during the SI. This section also includes a summary of the field and laboratory Quality Assurance/Quality Control (QA/QC) sample results.

2.1 DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative statements that specify the quality of the data required to support the decision-making process during the remedial response activities. The intended final use of the data determines the DQOs.

The credibility of data is buttressed by the level of the supporting QA/QC documentation. The greater the importance of the data or the resulting decision, the more QA/QC supporting information is needed to demonstrate the validity of the data. Data collected must be of sufficient quality in the SI to support decisions either to eliminate sites or individual matrices (e.g. soil) or to recommend further investigation.

The data collected during the SI fell into three categories: HAZWRAP Levels A, B, and C. A detailed discussion of the rationale for the number and location of sample points is presented in the SAP.

2.1.1 Level A, Field Surveys

Level A encompassed field monitoring activities and required no data package deliverables. Instruments used to produce Level A data included:

- Portable organic vapor monitoring instruments such as HNu Systems Model PI101 and an Organic Vapor Analyzer (OVA) Model #128

- pH meters

- Thermometers

- Conductivity meters

An HNu was used to monitor sampling sites, and an OVA was employed to screen field samples for total organic vapors. pH, temperature, and conductivity were measured in the field for all groundwater and surface water samples. Each instrument was calibrated using the manufacturer's directions. Calibration results were recorded in the field calibration logbook and sample results in the field notebooks. No additional QA/QC supporting documentation was necessary for this level.

Monitoring results, as well as other pertinent information concerning the sampling event, were logged in the field notebooks. The OVA measurements for each sample interval are noted on the soil boring logs included in Appendix C. The data generated from field monitoring were used to make decisions on how the investigation was executed (such as approximating the relative degree of contamination) or to provide general sample screening before analysis by the CSL and analytical laboratory.

2.1.2 Level B, CSL Screening Activities

A gas chromatograph (GC) was used in the CSL to screen soil and water samples for target VOCs. VOCs were chosen as target compounds because the PA stated that the primary sources of contamination were petroleum, oils, and lubricants (POLs) and spent solvents. Because of their mobility and detectability at low concentrations, VOCs served as good indicators of contamination. The CSL target compounds included:

- Benzene
- Dichloroethene
- Ethylbenzene
- Toluene
- Tetrachloroethene
- Trichloroethene
- Total xylenes

The CSL results were used to locate monitoring wells and optional borings. The data were not directly used to support the PRE. CSL results are summarized in Appendix D. Data package deliverables included sample, instrument calibration (initial and continuing), spiked sample, and method blank results.

2.1.3 Level C, Analytical Laboratory Analyses

Analytical methods were chosen based on information presented in the Preliminary Assessment. A portion of the samples screened in the CSL were submitted to the CH2M HILL analytical laboratory for Level C analysis. Samples were analyzed for:

- VOCs
- SVOCs
- Eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver)

Groundwater samples were analyzed for total and dissolved metals. Additionally, groundwater samples for Site 2 were analyzed for EDB using EPA Method 504.

The purpose of the Level C data was to:

- Provide a broad characterization of contaminants
- Support the PRE (Section 4)
- Serve as the basis for decisions for further action, if needed
- Serve as the basis for DDs for no further action, if appropriate

Level C analytical parameters were selected based on the suspected sources of contamination and on experience gained from previous ANG SIs. Samples were analyzed using Contract Laboratory Program (CLP) methods and the Level C data package deliverables are summarized in Table 2.1. All Level C data were reviewed and validated using the guidelines presented in the HAZWRAP document DOE/HWP-65. The results of the data review and validation process are presented in Appendix E.

2.2 FIELD ACTIVITIES SUMMARY

As discussed in Section 1 and summarized in Table 2.2, SI activities were divided into three categories: screening, confirmatory, and optional. The following activities were included during screening:

- Evaluating historical aerial photographs to establish the locations of potential contaminant source areas

- Installing piezometers and evaluating groundwater flow direction

- Performing a GPS and Soil Gas Survey at Site 2

- Sampling soil, groundwater (piezometers), stream sediment, and surface water for analysis in the CSL

Samples collected as part of the screening activities were evaluated for a limited number of target compounds in the onsite CSL. Selected samples were split and a portion of the samples submitted to the analytical laboratory for confirmatory Level C analyses. The screening results then were used to implement the confirmatory activities.

Confirmatory activities also included collecting samples from soil borings, stream sediment, surface water, and monitoring wells and submitting them to the analytical laboratory for Level C analysis. During the optional phase, additional borings and monitoring wells were installed based on the CSL data and field observations.

2.2.1 Screening Activities

2.2.1.1 Aerial Photography

Aerial photographs dating back to 1951 that included the IRP sites were obtained from the Agricultural Stabilization and Conservation Services, Salt Lake City, Utah.

Table 2.1
Level C Data Package Deliverables

CLP Form	Purpose
ORGANICS--GC	
I	Sample results
II	Surrogate spike results
III	MS/MSD spike results
IV	Method data blank
VI	Initial calibration data
VII	Continuing calibration data
VIII	Internal standard area data
**	Second column confirmation data
ORGANICS--GC/MS	
I	Sample results
II	Surrogate spike results
III	MS/MSD spike results
IV	Method blank data
V	GC/MS tuning data
VI	Initial calibration data
VII	Continuing calibration data
VIII	Internal standard area data
METALS	
I	Sample results
II	Initial and continuing calibration data
III	Method blank results
IV	ICP interference check sample results
V	Spike recovery data
VI	Duplicate sample results
VII	Laboratory control sample results
VIII	Standard addition results
X	Holding times

Notes:
MS/MSD: Matrix spike/matrix spike duplicates.
GC/MS: Gas chromatography/mass spectrometry.
ICP: Inductively coupled plasma.
CLP: EPA contract laboratory program.

Table 2.2
Field Sample Summary
Gulfport Field Training Site, Gulfport, Mississippi

	Screening		Confirmational			Optional	
Site	**Piezometers**	**Ground-water Probes**	**Borings**	**Monitoring Wells**	**Ditch Samples**	**Borings**	**Monitoring Wells**
Background	--	--	3	3	--	--	--
1-FTA	3	--	3	1	3	--	2
2-JP-4 Bulk Storage Area on Mill Road	5	43	9	3	--	3	3
3-Motor Pool Above Ground Diesel Storage Tank	3	--	3	1	--	--	--
Total	11	43	18	8	3	3	5

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Photographs were obtained for the years 1951, 1958, 1970, 1981, and 1985. A historical review of the photographs was performed to evaluate land use and construction changes over time and to locate each SI site.

Using the photographs, it was possible to identify the approximate locations of the two old AVGAS tanks at Site 2, and the JP-4 Bulk Storage facility on Mill Road. According to the photographs, one tank structure was located to the northwest of the facility fenceline on vacant property and one was located southeast of the existing JP-4 tank, inside of the fenceline. The aerial photographs were used to locate field sampling points.

2.2.1.2 Groundwater Probe Sampling and Soil Gas Surveys

GPS and soil gas surveys were conducted as part of the initial field screening activities at Site 2. The methods and results of the GPS and soil gas surveys are presented in Appendix F.

The GPS survey consisted of collecting shallow groundwater samples by driving a steel casing into the saturated zone to a depth of 3 to 6 feet. A stainless steel bailer was lowered down the casing to collect the water samples. Samples were placed in glass vials, sealed, labeled, and taken to an onsite mobile laboratory for analysis.

Surficial soils at Site 2 consisted primarily of low permeability clay and/or silt that yielded inadequate groundwater sample volume to perform the screening analyses for several sample locations. Four surface water samples (one bayou and three surface puddles) and 38 groundwater samples were collected from Site 2 and analyzed.

Because of the inadequate yield of some GPS survey sample locations, a field decision was made to collect soil gas samples where possible to increase the number of sample locations. The soil gas survey consisted of collecting shallow soil gas samples by driving a 1/2-inch diameter rod into the subsurface to a depth of 1 to 4 feet. A stainless steel probe was lowered down the open hole and sealed from ambient air. Ambient air trapped within the sampling system was purged with in-situ soil gas, and then a sample was withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure. The self-sealing vial was detached from the sampling system, packaged, labeled, and taken to the onsite mobile laboratory for analysis of benzene, toluene, ethylbenzene, and xylene (BTEX). Forty-three soil gas samples were collected from Site 2 and analyzed.

2.2.1.3 Borings and Soil Sampling

Eighteen soil borings were drilled at Sites 1, 2, and 3 to identify potential source areas for groundwater contamination. Soil samples also were collected at three background locations. Boring data are summarized in Table 2.3. Three samples from each Site 1 and Site 2 boring and two samples from each Site 3 boring were submitted to the CSL for Level B screening analysis. Additionally, one soil sample selected from each

Table 2.3
Boring, Piezometer, and Monitoring Well Construction Data
Gulfport Field Training Site, Gulfport, Mississippi

Site Location	Borings, Piezometers and Monitoring Wells	Date Drilled	Total Depth (ft bgs)	Screen Interval (ft bgs)	Elevation of Top of Screen (ft msl)	Elevation of Top of Casing (ft msl)	Ground Surface Elevation (ft msl)	Water Level Elevation 5/91 (ft msl)	Water Level Elevation 6/91 (ft msl)
Site 1	S1-B1	5/7/91	6	N/A	N/A	N/A	21.1	N/A	N/A
	S1-B2	5/7/91	6	N/A	N/A	N/A	21.3	N/A	N/A
	S1-B3	5/7/91	6	N/A	N/A	N/A	21.0	N/A	N/A
	S1-PZ1	5/7/91	10	4.5-7.0	18.3	25.01	22.8	21.84	21.17
	S1-PZ2	5/7/91	10	4.5-7.0	17.3	24.38	21.8	20.51	20.41
	S1-PZ3	5/3/91	10	7.5-10.0	13.8	23.72	21.3	21.15	20.35
	S1-MW1	5/9/91	10	4.5-7.0	17.7	25.18	22.2	---	20.70
	S1-MW2	5/9/91	10	4.5-7.0	17.6	25.18	22.1	---	20.61
	S1-MW3	5/9/91	10	4.5-7.0	17.2	24.63	21.7	---	19.76

Notes:
ft bgs: Feet below ground surface.
ft msl: Feet, mean sea level.
N/A: Does not apply to borings.
---: Water level measurements before the monitoring wells and background wells were installed.

Table 2.3 (Cont'd)
Boring, Piezometer, and Monitoring Well Construction Data
Gulfport Field Training Site, Gulfport, Mississippi

Site Location	Borings, Piezometers and Monitoring Wells	Date Drilled	Total Depth (ft bgs)	Screen Interval (ft bgs)	Elevation of Top of Screen (ft msl)	Elevation of Top of Casing (ft msl)	Ground Surface Elevation (ft msl)	Water Level Elevation 5/91 (ft msl)	Water Level Elevation 6/91 (ft msl)
Site 2	S2-B1	5/15/91	6	N/A	N/A	N/A	7.1	N/A	N/A
	S2-B2	5/15/91	6	N/A	N/A	N/A	7.4	N/A	N/A
	S2-B3	5/15/91	6	N/A	N/A	N/A	7.4	N/A	N/A
	S2-B4	5/15/91	6	N/A	N/A	N/A	4.9	N/A	N/A
	S2-B5	5/15/91	6	N/A	N/A	N/A	6.5	N/A	N/A
	S2-B6	5/15/91	6	N/A	N/A	N/A	8.5	N/A	N/A
	S2-B7	5/14/91	6	N/A	N/A	N/A	3.5	N/A	N/A
	S2-B8	5/16/91	5	N/A	N/A	N/A	5.1	N/A	N/A
	S2-B9	5/16/91	5	N/A	N/A	N/A	5.7	N/A	N/A
	S2-B10	5/14/91	6	N/A	N/A	N/A	4.9	N/A	N/A
	S2-B11	5/15/91	6	N/A	N/A	N/A	6.2	N/A	N/A
	S2-B12	5/15/91	6	N/A	N/A	N/A	6.7	N/A	N/A
	S2-PZ1	5/13/91	14	11.5-14.0	-6.9	4.40	4.6	2.35	1.65
	S2-PZ2	5/13/91	14	11.5-14.0	-2.9	11.27	8.6	6.47	5.56
	S2-PZ3	5/13/91	10	7.5-10.0	-4.6	5.27	2.9	2.72	1.96
	S2-PZ4	5/14/91	14	8.5-11.0	-0.3	11.34	8.2	4.86	3.96
	S2-PZ5	5/14/91	10	7.5-10.0	-3.3	6.59	4.2	2.12	1.42
	S2-MW1	5/20/91	14	7.0-12.0	-0.6	6.33	6.4	---	2.38
	S2-MW2	5/20/91	13.5	6.0-11.0	1.6	7.47	7.6	---	4.63
	S2-MW3	5/17/91	16	8.5-13.5	-4.2	7.57	4.3	---	1.79
	S2-MW4	5/17/91	16	8.5-13.5	-4.9	6.50	3.6	---	1.89
	S2-MW5	5/16/91	20	12.2-17.2	-7.8	7.32	4.4	---	1.44
	S2-MW6	5/20/91	6.0	1.0-6.0	2.4	5.67	3.4	---	1.83

Notes:
ft bgs: Feet below ground surface.
ft msl: Feet, mean sea level.
N/A: Does not apply to borings.
---: Water level measurements before the monitoring wells and background wells were installed.

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Table 2.3 (Cont'd)
Boring, Piezometer, and Monitoring Well Construction Data
Gulfport Field Training Site, Gulfport, Mississippi

Site Location	Borings, Piezometers and Monitoring Wells	Date Drilled	Total Depth (ft bgs)	Screen Interval (ft bgs)	Elevation of Top of Screen (ft msl)	Elevation of Top of Casing (ft msl)	Ground Surface Elevation (ft msl)	Water Level Elevation 5/91 (ft msl)	Water* Level Elevation 9/91 (ft msl)
Site 3	S3-B1	5/5/91	5	N/A	N/A	N/A	22.7	N/A	N/A
	S3-B2	5/5/91	5	N/A	N/A	N/A	27.8	N/A	N/A
	S3-B3	5/5/91	5	N/A	N/A	N/A	22.7	N/A	N/A
	S3-PZ1	4/30/91	14	8.5-13.5	14.3	22.69	22.8	20.73	19.28
	S3-PZ2	5/1/91	14	5.7-10.7	17.2	22.75	22.9	20.67	19.62
	S3-PZ3	4/30/91	16	10.4-15.4	12.1	22.31	22.5	20.26	18.96
	S3-MW1	5/1/91	10	5.0-10.0	17.7	22.46	22.7	---	19.60
Background Wells	BKGD-MW1	5/2/91	12	12.0-17.0	9.5	24.48	21.5	---	20.43
	BKGD-MW2	5/16/91	30	12.0-17.0	-5.6	9.50	6.4	---	2.20
	BKGD-MW3	5/2/91	22	4.5-9.5	18.4	22.81	22.9	---	19.49

Notes:
ft bgs: Feet below ground surface.
ft msl: Feet, mean sea level.
N/A: Does not apply to borings.
---: Water level measurements before the monitoring wells and background wells were installed.
*: Water level readings for Site 3 taken 9/91.

boring was submitted to the analytical laboratory for Level C confirmatory analysis. The selection criteria for laboratory analysis primarily depended on depth, water table elevation, and HNu monitoring results. The Level B CSL results are summarized in Appendix D and the Level C analytical results are summarized in Appendix G.

Soil borings were advanced using a CME 750 Model ATV drill rig equipped with 3.25-inch inner diameter (ID) hollow-stem augers. The soil was sampled continuously to about 6 feet at 2-foot intervals using split-spoon samplers. Each 2-foot sample was classified using the Unified Soil Classification System and the resulting soil description was recorded on a soil boring log form. The soil boring logs are presented in Appendix C. One granular and cohesive soil sample from each background location was submitted for geotechnical laboratory analyses. The results are presented in Table 2.4. These data were used to verify field logging descriptions of soil samples.

The down-hole drilling equipment was steam-cleaned between each boring. Any reusable sampling equipment, such as split-spoons, was decontaminated by:

- Washing with a trisodium phosphate detergent
- Rinsing with tap water
- Rinsing with deionized water
- Rinsing with methanol
- Rinsing with deionized water

The deionized water was supplied in large quantity lots from the CH2M HILL analytical laboratory. This deionized water also was used for rinsate blanks and field blanks.

When soil samples were collected for Level C analysis of VOCs, the split-spoon samplers were lined with brass sleeves. The liners were decontaminated as outlined above before each use.

2.2.1.4 Surface Water, Surface Soil, and Sediment Sampling

Three stream sediment samples were collected at two depths (0 to 6 inches and 30 to 36 inches) along the stream at Site 1. Samples were submitted to the CSL for Level B screening analysis. Four paired sediment (both depths) samples from the stream were submitted to the analytical laboratory for Level C analysis. Sediment samples were collected using a stainless steel hand-auger that was decontaminated between use at different sampling locations.

Three surface water samples were collected at the same locations as the three sediment samples from the stream at Site 1. The samples were submitted to the CSL for Level B screening analysis. Two of the samples were submitted to the analytical laboratory for Level C analysis. The samples were collected by placing the sample container in the water (approximately 6 to 18 inches deep) with the mouth of the jar facing upstream to allow the water to flow into the sample container.

Table 2.4
Laboratory Test Results
Gulfport Field Training Site, Gulfport, Mississippi

Boring & Sample Number	Depth of Sample	Water Content (%)	Atterberg Limits		Dry Unit Wt. (pcf)	Mechanical Analysis (% Passing)							Silt Clay (%)	Hydraulic Conductivity (cm/sec)
			LL	PI		4	10	20	40	60	100	200		
BKGD-MW1	10.0-12.0	25.2	28.6	11.7	101.0	100	100	99.9	98.7	90.9	67.6	22.6	SI-4.9 CL-17.7	1.0×10^{-6}
BKGD-MW1	4.0-6.0	23.1				100	99.9	99.8	99.3	93.5	63.0	16.7		
BKGD-MW2	4.0-6.0	21.9	23.0	7.5		100	100	100	99.8	98.1	77.3	35.0	SI-15.1 CL-19.9	2.3×10^{-7}
BKGD-MW2	14.0-16.0	20.1			106.7	100	100	100	98.8	80.0	42.6	10.8		
BKGD-MW3	20.0-22.0	54.9	70.7	53.9	62.9	100	100	100	99.9	99.3	95.2	79.3	SI-49.7 CL-29.6	2.5×10^{-8}
BKGD-MW3	6.0-8.0	19.6				100	100	99.7	84.6	35.8	9.4	6.4		

Notes:
LL: Liquid limit
PI: Plasticity index
pcf: Pounds per cubic foot
SI: Silt
CL: Clay

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2.2.1.5 Piezometers

Figure 2.1 illustrates the construction of a typical piezometer. Piezometer construction data are summarized in Table 2.3. The piezometers were constructed according to HAZWRAP specifications with 1.25-inch ID polyvinyl chloride (PVC) screen and well casing. The piezometer screens were 2.5 feet in length at Site 1, 2.5 feet in length at Site 2, and 5 feet in length at Site 3. Each piezometer screen was constructed with a 0.010-inch slot size. An artificial sand pack was installed to a depth of at least 2 feet above the top of each of the screens. A minimum 2-foot bentonite seal was placed above the sand pack, and the annulus was backfilled with drill cuttings to the surface. The piezometers were completed with watertight locking caps.

Eleven shallow piezometers were installed and completed in a silty sand to an approximate total depth of 10 to 16 feet below land surface at Sites 1, 2, and 3. Once water level measurements had been taken, water samples were collected from the piezometers and submitted to the CSL for Level B screening analysis.

2.2.2 Confirmatory Activities

In addition to the confirmatory activities mentioned in Section 2.2.1, confirmatory activities included the placement and sampling of one downgradient monitoring well at Site 3, one downgradient monitoring well at Site 1, and three downgradient monitoring wells at Site 2. The monitoring wells installed at Sites 1, 2, and 3 were used to evaluate the presence of contaminants downgradient of the potential source areas.

Figures 2.2 and 2.3 illustrate the construction of above-ground and flush completion monitoring wells. Well construction data are summarized in Table 2.3. The monitoring wells were constructed according to HAZWRAP specifications with 2-inch ID PVC screen and well casing. The monitoring well screens were 2.5 feet in length at Site 1, and 5 feet in length at Sites 2 and 3. All monitoring well screens were constructed with a 0.010-inch slot size. An artificial 20/40 grade sand pack was installed to a depth of at least 2 feet above the top of each of the screens. A minimum 2-foot bentonite seal was placed above the sand pack, and the annulus was grouted to surface. Optional monitoring well S2-MW6 at Site 2 was an exception to this type of well construction. This well was completed as a free product indicator well. The top of the well screen at S2-MW6 was installed 1 foot below ground surface so that the bentonite seal extended to ground surface. Each monitoring well was completed with a watertight locking cap inside a concrete apron. All downhole well materials were decontaminated before the monitoring well was installed.

After the monitoring wells were developed, a groundwater sample was collected and submitted to both the CSL and the analytical laboratory. Temperature, pH, and

PIEZOMETER COMPLETION

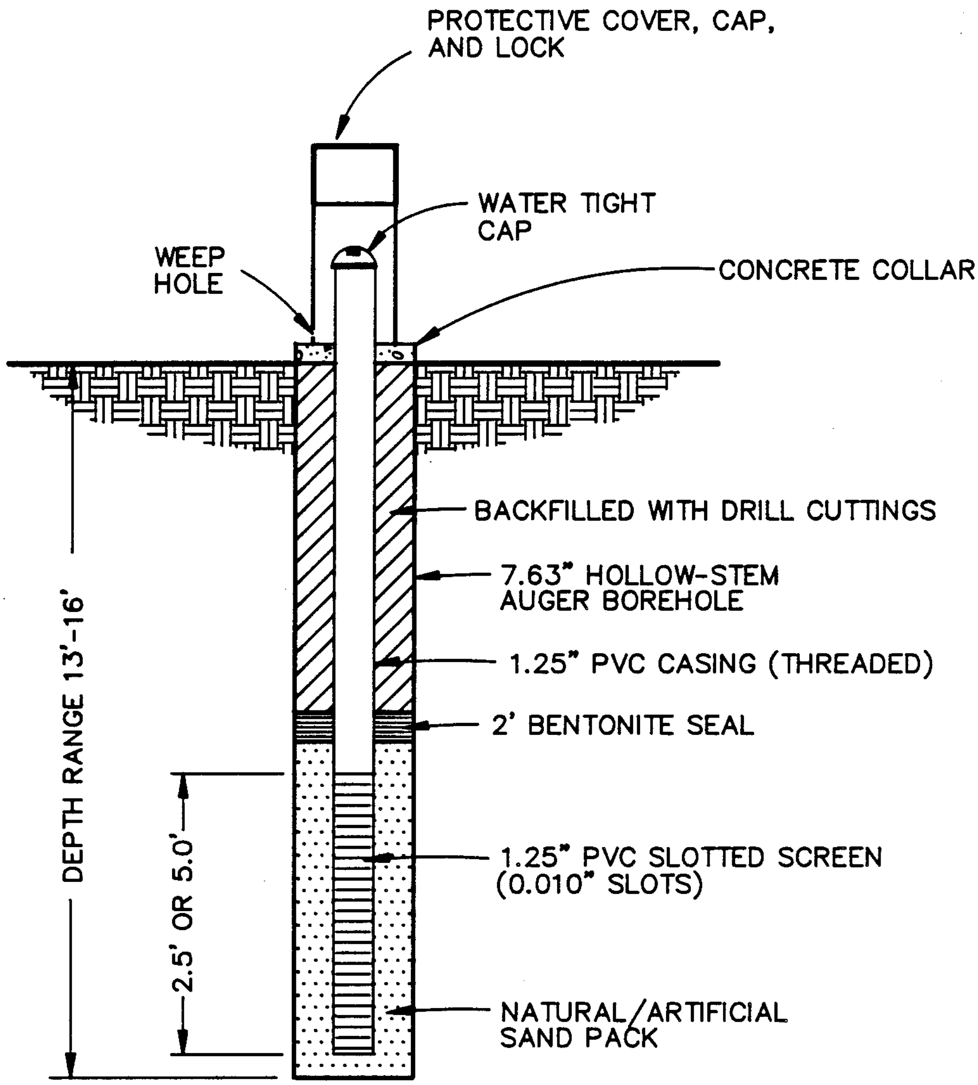

FIGURE 2.1
TYPICAL PIEZOMETER CONSTRUCTION
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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MONITORING WELL COMPLETION

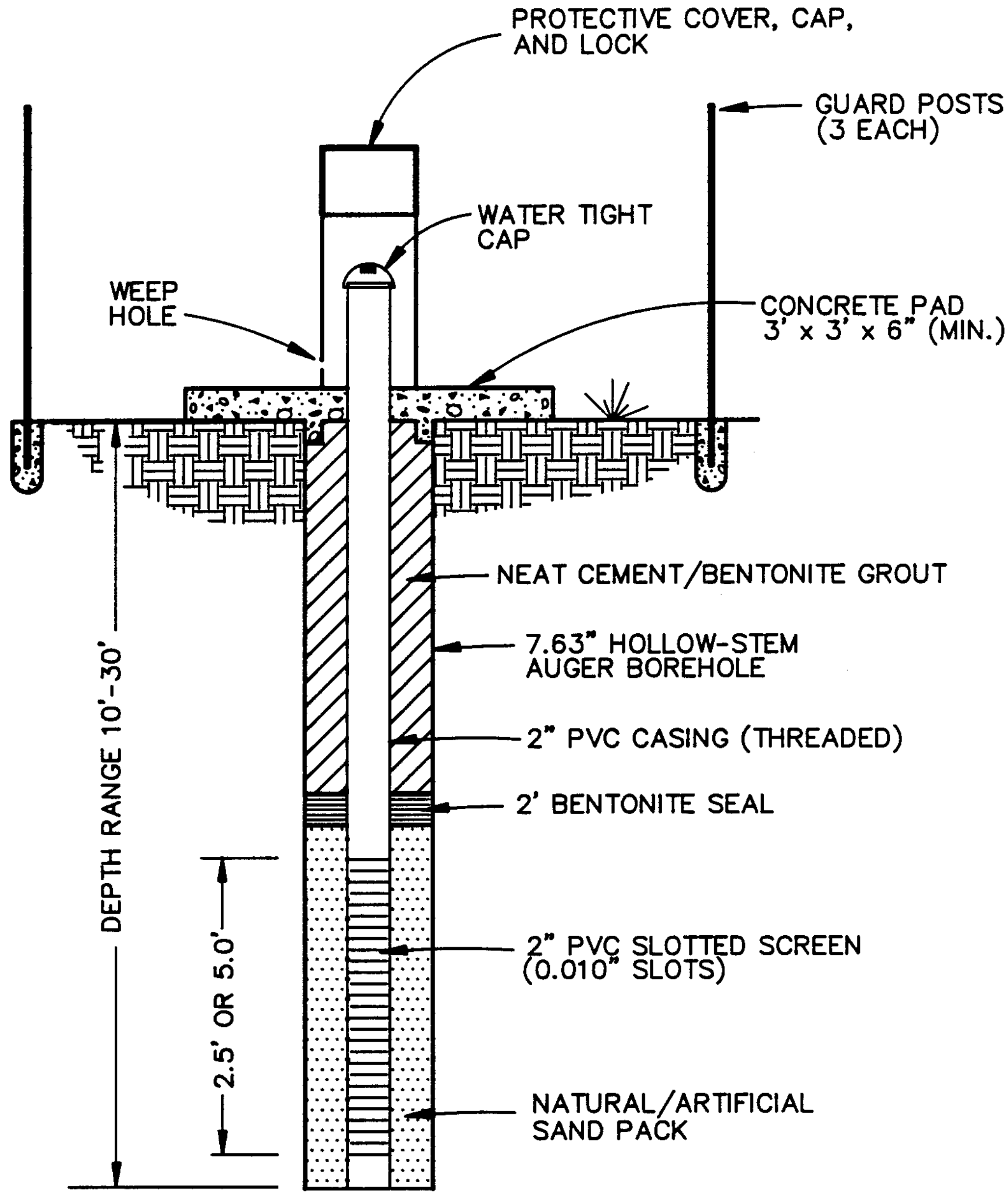

FIGURE 2.2
TYPICAL MONITORING WELL CONSTRUCTION
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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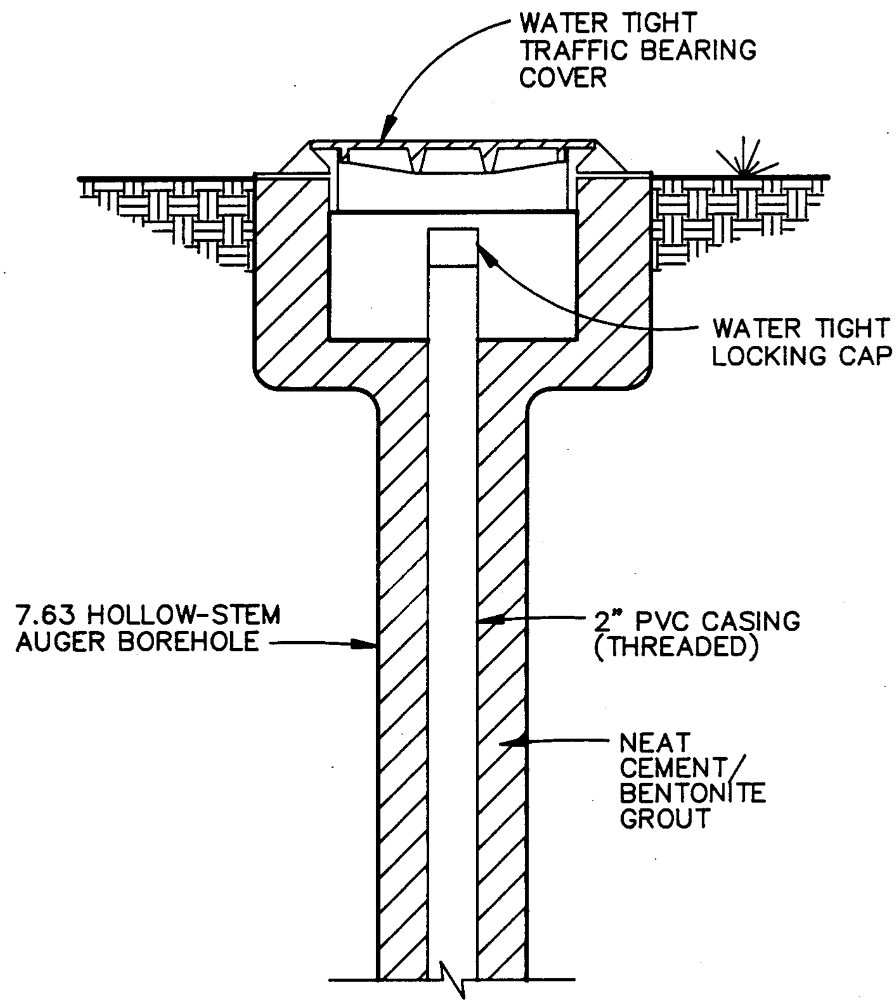
FLUSH COMPLETION



NOTE:

THE NEAT CEMENT/BENTONITE GROUT, BENTONITE SEAL, PVC SCREEN, AND, NATURAL/ARTIFICIAL SANDPACK ARE INSTALLED AS PER FIGURE 2.2.

FIGURE 2.3
TYPICAL MONITORING WELL FLUSH COMPLETION
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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specific conductivity of the groundwater samples are summarized in Table 2.5. The CSL results and field observations were used to implement optional work. Each well was sampled twice, about one month apart, for Level C samples.

2.2.3 Optional Activities

Optional activities conducted at Sites 1 and 2 included soil borings and monitoring wells. Optional work was done following review of the CSL data and field observations in an attempt to fill data gaps.

The CSL results indicated target analytes above method detection limits in the soil and groundwater at Site 1. Based on an evaluation of the CSL results, the presence of the adjacent stream and its possible influence on groundwater flow direction, and water level measurements, it was decided that two optional monitoring wells should be installed at Site 1. The installation of these monitoring wells provided a larger surface area that could be explored, thereby decreasing the likelihood of missing contaminant migration away from the Site 1.

Two optional monitoring wells were installed at Site 1, each to a total depth of about 10 feet with 2.5 foot well screens. The monitoring wells were constructed, completed, and developed as described above in Section 2.2.2. One groundwater sample from each monitoring well was split and a portion was submitted to the CSL for Level B screening analysis and to the analytical laboratory for Level C analysis. Additionally, both optional monitoring wells were resampled during the second round of well sampling in June 1991.

The GPS and soil gas surveys conducted at Site 2 indicated the presence of fuel contamination throughout the site; therefore, three optional soil borings were drilled at Site 2 so that potential source areas could be located. These three soil borings were drilled to a depth of 6 feet, and the soils were sampled continuously. Soil samples were collected from the 0 to 2, 2 to 4, and 4 to 6 foot depth intervals and submitted to the CSL for Level B analysis. One sample from each soil boring was split and submitted to the analytical laboratory for Level C confirmatory analysis.

Three optional monitoring wells were installed at Site 2 because the CSL results indicated the presence of contamination in the soil and groundwater throughout the site. The purpose of the optional monitoring wells was to evaluate the concentration of groundwater contaminants at the downgradient property lines and to evaluate the presence of free product on the water table. Monitoring well S2-MW6 was specifically installed to evaluate whether free product was present.

Groundwater samples from the three optional wells were submitted to the CSL for Level B screening analysis and the analytical laboratory for Level C analysis. Additionally, the three optional wells were sampled for a second time during the second round of well sampling in June.

Table 2.5 Summary of Statistics of Field Parameters for Groundwater Sampling Gulfport Field Training Site, Gulfport, Mississippi							
		pH		Specific Conductivity (μmhos)		Temperature (°C)	
Sites	**Samples**	**5/91**	**6/91**	**5/91**	**6/91**	**5/91**	**6/91**
Site 1	S1-PZ1	6.20	----	800	----	25.0	----
	S1-PZ2	6.11	----	670	----	25.5	----
	S1-PZ3	5.51	----	125	----	23.5	----
	S1-MW1	5.40	6.72	600	900	24.7	23.0
	S1-MW2	5.05	6.65	780	1,050	28.5	23.0
	S1-MW3	6.90	6.47	280	275	26.0	23.5
Site 2	S2-PZ1	----	----	145	----	23.9	----
	S2-PZ2	----	----	96	----	----	----
	S2-PZ3	----	----	760	----	----	----
	S2-PZ4	----	----	150	----	----	----
	S2-PZ5	----	----	400	----	----	----
	S2-MW1	4.95	5.06	125	135	21.3	21.5
	S2-MW2	4.97	4.62	275	290	21.4	22.5
	S2-MW3	5.48	5.49	205	215	20.7	23.0
	S2-MW4	6.25	6.12	830	1,000	21.3	23.0
	S2-MW5	6.20	6.21	440	455	21.7	21.0
	S2-MW6	6.36	6.48	6,600	7,250	22.7	24.5
Site 3	S3-PZ1	5.98	----	75	----	24.5	----
	S3-PZ2	6.10	----	110	----	23.0	----
	S3-PZ3	6.90	----	220	----	24.0	----
	S3-MW1	5.45	4.99	90	110	24.0	24.0
Background	BKGD-MW1	6.07	6.44	205	305	26.0	23.0
	BKGD-MW1	4.87	4.72	150	150	21.4	21.0
	BKGD-MW3	5.52	5.38	110	145	24.5	24.0
Minimum		4.87	4.62	75	110	20.7	21.0
Maximum		6.90	6.72	6,600	7,250	28.5	24.5
Average		N/A	N/A	593	945	23.7	22.8
Standard Deviation		N/A	N/A	1,306	1,925	2.1	1.1

Notes:
---: Parameters not analyzed.
N/A: Average and standard deviation values are not applicable to pH values.
μmhos: Micromhos.
°C: Degrees celcius.

2.2.4 Background Sampling

A background boring was drilled at each of the three sites in areas expected to be unaffected by past waste disposal practices. The borings were advanced to an approximate depth of 12 feet at Site 1, 30 feet at Site 2, and 22 feet at Site 3, using the same methods as the other soil borings. Soil samples were collected at 0 to 2, 2 to 4, and 4 to 6 foot intervals, and the samples were submitted to the CSL. One split soil sample from each boring was submitted to the analytical laboratory.

Each of the three borings was completed as a monitoring well by the construction methods described in Section 2.2.2. Groundwater samples were collected and submitted to the CSL and the analytical laboratory. Each background monitoring well was sampled a second time for Level C analysis during the second round of well sampling.

2.2.5 Disposal of Investigation-Derived Wastes

Wastes generated during the SI included:

- Drill cuttings
- Well development water
- Decontamination water
- CSL laboratory waste
- Disposable personal protective equipment (PPE), e.g. Tyveks, gloves

Wastewater was collected, placed in containers, and the containers labeled by field team members. The drill cuttings were placed in a pile on plastic sheets next to each borehole and covered. Because all the work was performed at Level D personal protective status, the PPE was disposed of in onsite trash dumpsters.

Based on a review of the analytical results for the soil and water samples, it was concluded that the investigation-derived wastes were nonhazardous. Therefore, the soil was spread out on the ground at each drill site and the plastic was disposed of in onsite trash dumpsters. The water was disposed of by discharging it down the base sanitary sewer, as agreed to with the ANG and the Harrison County Wastewater Management District. The wastewater was disposed of during the week of 27 April to 1 May 1992.

The CSL laboratory waste was determined to be nonhazardous and was placed in garbage bags that were hand delivered to the analytical laboratory for proper disposal.

2.3 Quality Assurance/Quality Control

2.3.1 Field QA/QC

2.3.1.1 Field QA/QC Samples

Field QC samples were not required for Level B screening samples; therefore, field QC samples were collected only on days when Level C samples were collected. Three types of field blank QC samples were used to monitor the existence and magnitude of contamination problems introduced by field errors. The three types were:

Equipment Rinsate Blank—After the piece of sampling equipment was decontaminated, it was rinsed with American Society of Testing and Materials (ASTM) Type II water (provided by the analytical laboratory); a sample of this final rinse water was submitted as an equipment rinsate blank. This blank was used to monitor contamination that may have been introduced because of incomplete equipment decontamination. One rinsate blank per day was analyzed for the same analytical parameters as the corresponding samples.

Field Blank—This was a sample of the water that was used for rinsing equipment. This blank was used to monitor contamination that may have been introduced by the rinse water. One field blank for each batch of decontamination water, or one per field event, was analyzed for the same parameters as the corresponding field samples.

Trip Blank—This was used to monitor possible VOC contamination during the sample container trip. This blank consisted of a VOC sample container (40 mL vial) that was filled in the analytical laboratory with ASTM Type II water before being sent to the field. The trip blank sample container was not opened in the field and was shipped back to the laboratory in a cooler containing field samples for VOC analyses. One trip blank was included in each shipping container that contained samples for Level C VOC analysis.

Additionally, one duplicate field sample was collected for every 10 field samples of the same matrix. Field duplicate samples were used to monitor sampling accuracy and precision.

2.3.1.2 Field QA/QC Review

Tables 2.6 and 2.7 summarize the Level C organic and inorganic field blank results; only those analytes detected above the CLP contract required detection limit (CRDL) are included in the table. However, all the samples are included even if no target analytes were detected above the CRDL.

Table 2.6
Organic QC Sample Results Summary
Gulfport Field Training Site, Gulfport, Mississippi

Client Sample ID	Source	Lab Sample	Date Sampled	Bromo-dichloro-methane	Carbon Disulfide	Chloro-form	Methylene Chloride
Detection Limits and Units				5 µg/L	5 µg/L	5 µg/L	5 µg/L
TB1-5/1		18463005	5/1/91				
TB2-5/2		18470003	5/2/91				
TB3-5/3		18483004	5/3/91				
TB4-5/7		18505009	5/7/91				
TB5-5/7		18505014	5/7/91				
TB6-5/8		18521004	5/8/91				
TB7-5/9		18531002	5/9/91				
TB8-5/10		18539006	5/10/91				
TB9-5/14		18551004	5/14/91				
TB10-5/15		18560010	5/15/91				
TB11-5/15		18560011	5/15/91				
TB12-5/16		18572003	5/16/91				
TB13-5/17		18582003	5/17/91				
TB14-6/20		18589006	6/20/91				
TB15-6/21		18598005	6/21/91				
TB16-6/22		18605005	6/22/91				
TB17-6/17		18771005	6/17/91				

Table 2.6 (Cont'd)
Organic QC Sample Results Summary
Gulfport Field Training Site, Gulfport, Mississippi

Client Sample ID	Source	Lab Sample	Date Sampled	Bromo-dichloro-methane	Carbon Disulfide	Chloro-form	Methylene Chloride
Detection Limits and Units				5 μg/L	5 μg/L	5 μg/L	5 μg/L
TB18-6/18		18785008	6/18/91				
TB19-6/19		18794009	6/19/91				
ER5-1	Hand-Auger	18463004	5/1/91		10		
ER5-2	Split-Spoon	18483002	5/2/91				
ER5-8	Hand-Auger	18505013	5/7/91				
ER5-10A	Bailer	18539003	5/10/91				
ER5-10B	Split-Spoon	18539004	5/10/91				
ER5-14	Bailer	18551003	5/14/91				
ER5-15	Split-Spoon	18560009	5/15/91		9		
ER5-16	Hand-Auger	18572002	5/16/91		5		
ER5-20	Bailer	18589003	5/20/91		6		
ER5-21	Bailer	18598004	5/21/91				
ER5-22	Bailer	18605004	5/22/91				
ER6-17	Bailer	18771004	6/17/91				29
ER6-18	Bailer	18785005	6/18/91		12		27
ER6-19	Bailer	18794008	6/19/91				
FB-3A	Lab	18483001	5/3/91				

Table 2.6 (Cont'd)
Organic QC Sample Results Summary
Gulfport Field Training Site, Gulfport, Mississippi

Client Sample ID	Source	Lab Sample	Date Sampled	Bromo-dichloro-methane	Carbon Disulfide	Chloro-form	Methylene Chloride
Detection Limits and Units				5 μg/L	5 μg/L	5 μg/L	5 μg/L
FB5-3B	Tap	18483003	5/3/91				
FB5-8A	Water Truck	18521002	5/8/91	7		90	
FB5-8B	Drill Rig	18521003	5/8/91			41	
FB5-9	Lab	18531001	5/9/91				
FB5-17A	Tap	18582001	5/17/91				
FB5-17B	Lab	18582002	5/17/91				
FB5-20A	Lab	18589004	5/20/91				
FB5-20B	Tap	18589005	5/20/91				
FB6-17	Lab	18771003	6/17/91				8

Notes:
ID: Identification
μg/L: Micrograms per liter.
TB: Travel Blank.
ER: Equipment Rinsate Blank.
FB: Field Blank.

Table 2.7
Inorganic QC Sample Results Summary
Gulfport Field Training Site, Gulfport, Mississippi

Client Sample ID	Rinsate Source	Lab Sample ID	Date Sampled	Cadmium	Lead
Detection Limits and Units				5 μg/L	3 μg/L
ER5-1	Hand-Auger	18463004	5/1/91		
ER5-2	Split-Spoon	18483002	5/2/91	9.6	
ER5-8	Hand-Auger	18505013	5/7/91	5.4	
ER5-10A	Bailer	18539003	5/10/91		5.9
ER5-10B	Split-Spoon	18539004	5/10/91		
ER5-14	Bailer	18551003	5/14/91		
ER5-15	Split-Spoon	18560009	5/15/91		5.2
ER5-16	Hand-Auger	18572002	5/16/91		12.6
ER5-20	Bailer	18589003	5/20/91		
ER5-21	Bailer	18598004	5/21/91		3.1
ER5-22	Bailer	18605004	5/22/91		
ER6-17	Bailer	18771004	6/17/91		
ER6-18	Bailer	18785005	6/18/91		5.6
ER6-19	Bailer	18794008	6/19/91		
FB-3A	Lab	18483001	5/3/91		
FB5-3B	Tap	18483003	5/3/91		14.7
FB5-8A	Water Truck	18521002	5/8/91	7.0	5.4
FB5-8B	Drill Rig	18521003	5/8/91		31.5
FB5-9	Lab	18531001	5/9/91		
FB5-17A	Tap	18582001	5/17/91		
FB5-17B	Lab	18582002	5/17/91		
FB5-20A	Lab	18589004	5/20/91		6.4
FB5-20B	Tap	18589005	5/20/91		
FB6-17	Lab	18771003	6/17/91		

Notes:
ID: Identification.
TB: Travel Blank.
ER: Equipment Rinsate Blank.
FB: Field Blank.

Because QC samples were collected by the day rather than by site, an extra column has been added to the summary table that specifies the source of the QC sample. One trip blank was included in each cooler that contained samples for VOC analysis. If more than one cooler containing samples for VOC analysis was shipped on a given day, then trip blanks were included in all the coolers. One equipment rinsate blank was collected each day that Level C samples were collected. The source of the equipment rinsate blank (bailer, split spoon, or hand auger) is indicated in the second column. One field blank was collected from each source of decontamination water during each field event. The source of the water (tap water or ASTM Type II water from the laboratory) is indicated in the second column.

Low concentrations of both acetone and methylene chloride appeared in many of the field QC samples. Both of these chemicals are used as extraction solvents in the laboratory and hence are very common laboratory contaminants. The concentration of acetone and methylene chloride is less than 10 times the concentration detected in the corresponding laboratory method blanks. Therefore, the acetone and methylene chloride in samples can be attributed to laboratory contamination.

Carbon disulfide was detected in five of the fourteen equipment rinsate blanks at concentrations from 5 to 12 micrograms per liter (μg/L). The common chlorination by-products, bromodichloromethane and chloroform, were detected in the tap water used to decontaminate equipment. Cadmium appeared in 3 and lead in 9 of the 24 field QC samples.

2.3.2 Laboratory QA/QC

2.3.2.1 Laboratory QA/QC Samples

Method blanks were analyzed for both Level B and C samples before the field samples and during sample analysis at a frequency outlined in the appropriate analytical method. A method blank is ASTM Type II water that is treated as a sample in that it undergoes the same analytical process as the corresponding field samples. Method blanks were used to monitor laboratory performance and contamination introduced during the analytical process.

Level C laboratory QC samples can be categorized as either organic or inorganic QC samples. The two types of organic QC samples were:

- **Surrogate Spikes**—Surrogate spike recoveries served to estimate accuracy and were added to every sample. Surrogate compounds are the structural homologs of target compounds, often with deuterium substituted for hydrogen, and are therefore expected to behave in a similar manner during analysis. Spike recoveries were used to monitor both matrix effects and laboratory performance.

- **Matrix Spike/Matrix Spike Duplicates**—MS/MSDs were used to estimate the effect of the specific sample matrix on sample analyte recovery, as well as on accuracy and precision. Matrix spike compounds are found on the method target compound list (TCL). The field sample was split into thirds and two portions were spiked with known quantities of TCL compounds in order to ascertain the effects of the specific sample matrix on the recovery of these analytes of interest. One MS/MSD sample was analyzed for every 20 samples of the same matrix that were analyzed within a 14-day window.

The two types of Level C inorganic QC samples were Laboratory Control Samples (LCS) and spiked (both pre- and post-digestion) samples.

- **LCS**—An LCS consists of an ideal matrix (usually ASTM Type II water) that has been spiked with a known amount of the analyte of interest; the LCS was prepared (digested) and analyzed with the field samples. The LCS is designed to monitor the efficiency of the overall analytical procedure, including sample preparation, and the resulting analyte recoveries must fall within pre-established acceptance limits.

- **Spiked Samples**—Pre-digestion spikes are analogous to the MS/MSD spike recovery for organic analyses in that they measure the effects of the sample matrix on the recovery of a known quantity of analyte after both sample preparation and analysis. If the pre-digestion spike recovery did not fall within the acceptance window of 75 to 125 percent, then a post-digestion spike was added and the sample reanalyzed. The post-digestion spike monitors instrument performance and matrix effects. If both the pre- and post-digestion spike recoveries fell outside the acceptance limits, then the data were flagged to indicate the nonconformance.

- **Duplicate Samples**—Field samples were split in the laboratory and the duplicate results were used to estimated precision. Duplicate samples are analogous to the MS/MSD in that they measure the effects of the sample matrix on precision after sample preparation and analysis. If the precision of the duplicate results was greater than 20 percent (relative percent difference) then the results were qualified to indicate poor duplicate precision.

2.3.2.2 Data Review and Validation Summary

Before the analytical results were released by the laboratory, both the sample and QC data were carefully reviewed in order to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data were reduced and spike recoveries were included in control charts, and the resulting data were reviewed to

ascertain whether they were within the laboratory defined limits for accuracy and precision. Any non-conforming data were discussed in the data package cover letter and case narrative.

The Level C data packages were reviewed and validated by project team members. Data validation is the technical review of a data package using criteria established in the data quality objectives and the quality assurance project plan. The data were reviewed and validated using the HAZWRAP guidance document HWP-65, *QC Requirements for Laboratory Data*. The data review and validation process is independent of the laboratory's checks because it is impossible to repeat the laboratory's review because not all the raw data were included in the Level C data packages. A technical memorandum summarizing the results of the data review and validation process is included as Appendix E.

Samples that did not meet the acceptance limit criteria were qualified with a flag, single letter abbreviations that indicate a problem with the data. Flags used in the data summary tables include:

U Undetected. Analyte was analyzed for but not detected above the method detection limit. When used to qualify common laboratory contaminant data, the concentration of the common laboratory contaminant compound is less then 10 times the concentration detected in any of the corresponding blanks.

J Estimated. The analyte was present, but the reported value may not be accurate or precise.

B Estimated. The analyte was present, but the reported value may not be accurate or precise. Used for inorganic analyte concentrations greater than the instrument detection limit but less than the contract required detection limit.

It is important to note that the data summary forms, Form 1s, (included in Appendix J) also may have flags on them and the usage is the same as above with one major exception. Any organic compound that was detected in both the sample and the method blank was flagged with a B for possible laboratory contamination. However, during the data validation process all the target compounds flagged with a B were evaluated. For those common laboratory contaminants detected at a concentration less than 10 times (5 times for other compounds) the concentration in any of the corresponding blanks (both laboratory and field blanks), the qualifying flag was changed to a U for undetected. The qualifying flag was removed from those compounds that were detected at a concentration greater than 10 times the concentration in any of the corresponding blanks, and the result is considered to be the concentration in the environmental sample.

All of the acetone, methylene chloride, 2-butanone, and bis(2-ethylhexyl)phthalate present in the groundwater samples can be attributed to field sampling and laboratory contamination. However, some of the values for 2-butanone and methylene chloride in the soil samples were greater than 10 times the concentration in the corresponding method blank and these have been presented without a qualifying flag. However, because there is no historical evidence of methylene chloride use at the base and methylene chloride is not a common degradation product of fuel, the most common suspected contaminant at the site; and it is unlikely that the methylene chloride detected in the soil samples is due to environmental contamination and not laboratory contamination, and the report reflects this perspective.

Once the data were reviewed and validated according to the guidance presented in HWP-65, the data were evaluated using the precision, accuracy, representativeness, comparability, and completeness (PARCC) criteria included in the DQOs of the SAP.

2.3.3.1 Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under the same conditions. Precision was estimated from analytical data and cannot be measured directly. Precision was evaluated using field duplicate samples and laboratory split samples (for example, MS/MSD samples).

The criteria for evaluating precision presented in the SAP was 20 relative percent difference between duplicate results. Those duplicate analytical results that were not within 20 percent were flagged with a J for duplicate precision not met. This goal may not have been realistic for soil samples because of the heterogeneity of the sample matrix; all the soil duplicate results were within a more realistic acceptance window of -50 to +100 relative percent difference.

2.3.3.2 Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy also can be estimated from the analytical data and was not measured directly. For the organic analyses, each of the samples was spiked with a surrogate compound; and for inorganic analyses each sample was spiked with a known reference material before digestion. Each of these approaches provides a measure of the matrix effects on the analytical accuracy.

Target acceptance ranges for the spike recoveries are included in the analytical method. If the spike recovery fell outside the acceptance windows, then the sample data was qualified with a J as indicated on the data summary tables.

2.3.3.3 Representativeness

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter and is used to evaluate the efficacy of the sampling plan design. This criteria was satisfied for this project by fully describing in both the SAP and the SI report the sampling techniques and the rationale used for selecting sampling locations.

2.3.3.4 Comparability

Comparability is another qualitative measure designed to express the confidence with which one data set may be compared to another. Factors which affect comparability are: sample collection and handling techniques, sample matrix type, and analytical method. Comparability is limited by the other PARCC parameters because only when precision and accuracy are known can data sets be compared with confidence. Data from the two rounds of groundwater sampling can be compared directly because the sampling and analysis methods were specified in the SAP, and accuracy and precision data are available.

2.3.3.5 Completeness

Completeness is defined as the percentage of measurements which are judged to be valid compared to the total number of measurements made. A goal of 95 percent usable data was established in the SAP. None of the data were rejected during the data review and validation process; therefore, completeness is 100 percent.

2.3.5.6 Summary

Overall the data are acceptable for use with the qualifications indicated with the flags. One-hundred percent of the data were used to support the project decision-making process. When the wider acceptance windows of -50 to +100 relative percent difference were used to evaluate precision, greater than 95 percent of the data met this criteria. More than 95 percent of the MS/MSD spike recoveries were within the method acceptance range. None of the data were rejected during the data review and validation process.

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3. SIGNIFICANCE OF RESULTS

3.1 HYDROGEOLOGIC SETTING OF THE FACILITY

The purpose of this section is to describe the site-specific hydrogeologic setting at the Base. The information presented in this section was developed primarily during the SI field work and is limited to the surficial sediments most susceptible to contamination from waste disposal activities.

3.1.1 Surface Water Drainage

The Base lies within the Gulf Coastal area of Mississippi and is drained principally by the Biloxi River. Figure 3.1 is a topographic map showing surface water drainage for the Base and surrounding areas. One tributary, Bernard Bayou, flows eastward and passes within 1 mile of the northern boundary of the Base. Turkey Creek is a small tributary that joins Bernard Bayou just north of the Base. An unnamed tributary to Turkey Creek located adjacent to Site 1 is the primary receptor of surface water runoff from Site 1.

Brickyard Bayou is a stream and levee system that passes south of the Base and is a tributary to Bernard Bayou about 1 mile east of the Base just south of Site 2. Surface water runoff at Site 2 drains directly into Bernard Bayou.

Surface water runoff from Site 3 drains into a drainage ditch located between the dormitories at the Base and the eastern boundary of the Base and discharges into Bernard Bayou.

3.1.2 Geologic Framework

Surficial sediments at the Base were deposited in a shallow coastal environment. These deposits are referred to as the Pamlico sand. This formation crops out throughout much of the coastal plain around Gulfport. The Citronelle formation of the Pliocene and Pleistocene series that usually underlies the Pamlico sand is not present at the Base. The Pamlico sand is underlain by the tertiary deposits of the Graham Ferry formation. The Tertiary system and associated aquifers are described in Section 1.

Soil borings performed during the SI indicate that the Pamlico sand is at least 30 feet thick. The entire thickness of the formation was not penetrated. The Pamlico sand generally consists of gray and tan sand with some clay and silt deposits resulting from periods of lagoonal deposition. The formation near land surface consists of sandy loam that grades into sand and weathered chert pebbles. At greater depths the formation grades into gray bedded clay and yellow clayey sand with weathered chert pebbles.

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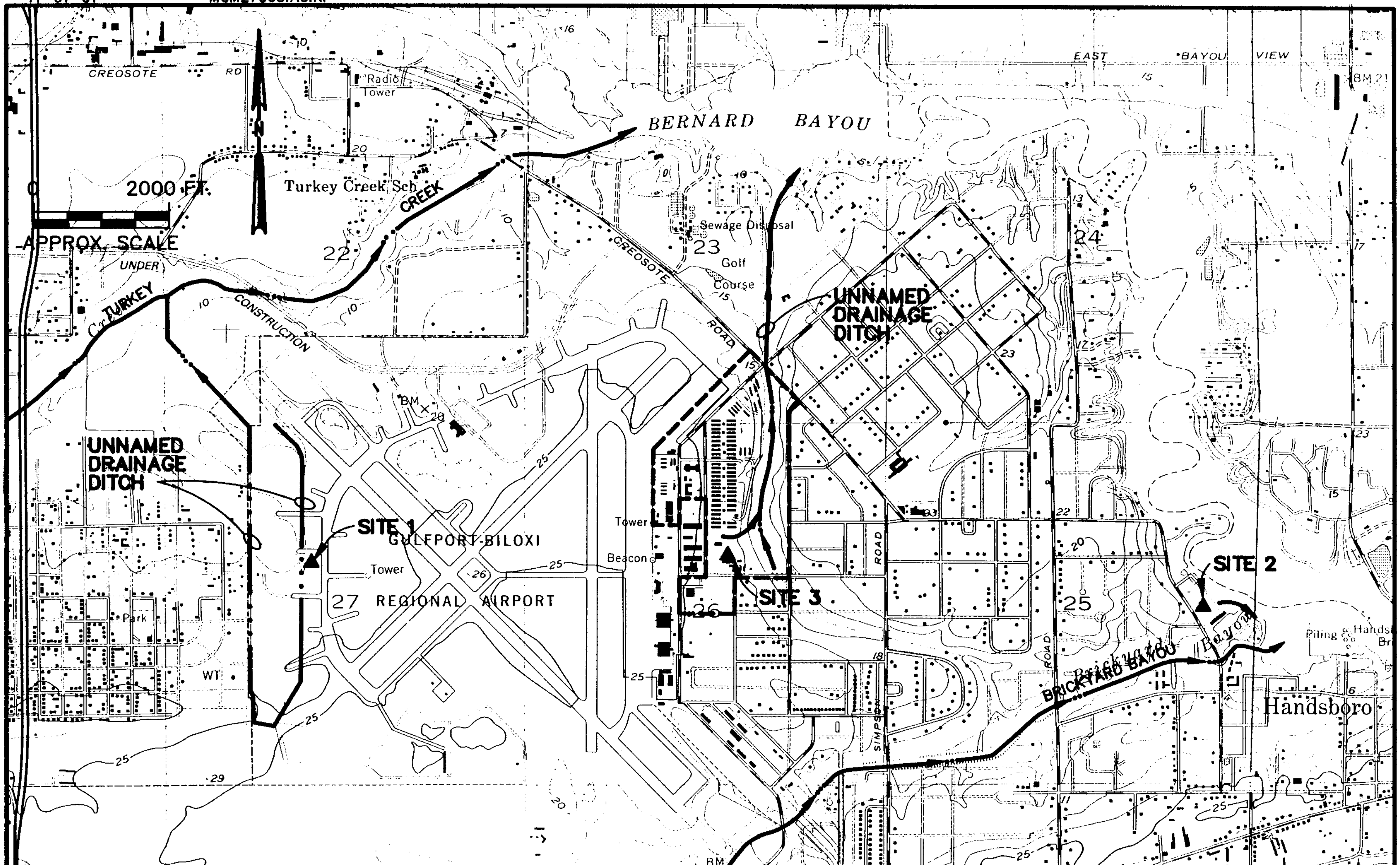

LEGEND

▲ APPROX. SITE LOCATION

→ DIRECTION OF DRAINAGE

FIGURE 3.1
SURFACE WATER DRAINAGE
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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GFP-0035.DWG

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3.1.3 Hydrogeologic Setting

The hydrogeologic setting of the Base consists of two major deep aquifers and a water table aquifer within the Pamlico sand that lies atop the Graham Ferry formation. Figure 3.2 is an illustration of a conceptual hydrogeologic model that depicts the aquifers, confining beds, and generalized groundwater flow directions.

Recharge to the surficial aquifer within the Pamlico sand is from infiltration of rainfall. Groundwater within the surficial aquifer discharges to the nearest open water channel such as Bernard Bayou, Turkey Creek, and Brickyard Bayou. The base of the surficial aquifer is formed by low permeability clays at the top of the Graham Ferry formation. Regional data indicate that clay beds of the Graham Ferry may be discontinuous allowing hydraulic interconnection between the surficial aquifer and the underlying Graham Ferry aquifer.

The well inventory identified wells in all three aquifers. The inventory listed four wells completed in the surficial aquifer that are used for garden irrigation and water supply.

3.2 BACKGROUND SOIL AND GROUNDWATER SAMPLE RESULTS

Samples were collected from soil borings and respective monitoring wells BKGD-MW1, BKGD-MW2, and BKGD-MW3 in May 1991 to evaluate the presence of VOCs, SVOCs, and metals in soil and groundwater at unaffected background locations. Background groundwater samples were collected again in June 1991. The number of background samples is too small to conduct statistical analysis of the data. The purpose of the background sampling was to indicate which analytes are present naturally or from sources other than IRP sites and to give some indication of the concentration of these analytes in soil and groundwater matrices.

3.2.1 Location of Background Sample Points

The background monitoring well locations are shown on the figures included in the following sections which describe results at each site. One background monitoring well was located at each of the three sites in a relatively undisturbed location, and in an upgradient position relative to the IRP site. The location for monitoring well BKGD-MW1 was selected because of its distance from the FTA and upgradient direction from Site 1. Background monitoring well BKGD-MW2 is located at the southwestern corner of the fenceline at the property boundary of the JP-4 bulk storage area. This location was selected, based on CSL and GPS survey results, as the maximum distance upgradient of the storage tanks that was suitable for well installation within the property boundary. Similarly, the background monitoring well at Site 3 was located in an upgradient direction from the site and in a relatively undisturbed area.

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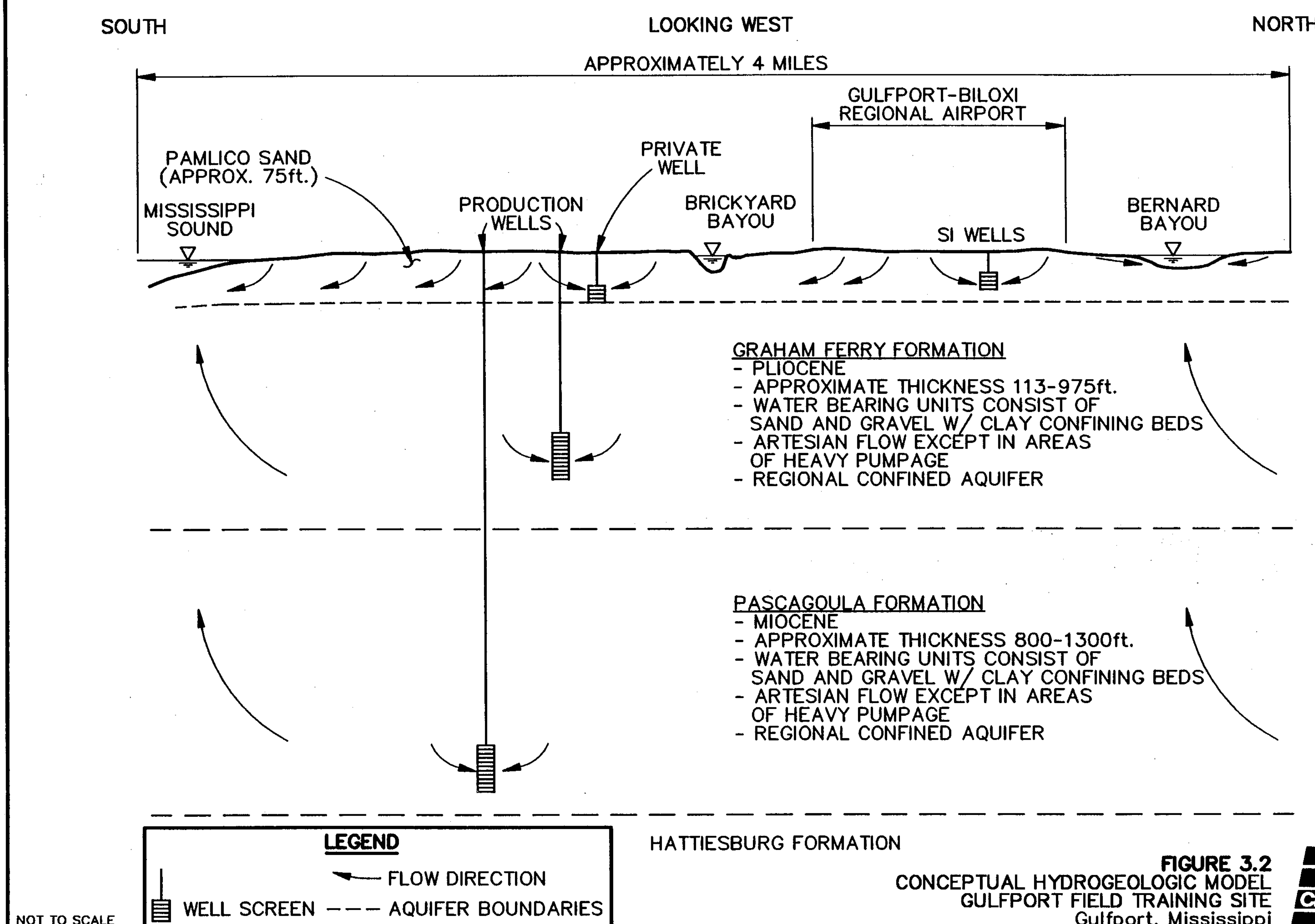

FIGURE 3.2
CONCEPTUAL HYDROGEOLOGIC MODEL
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

GFP-0051.DWG

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3.2.2 Results

Background soil and groundwater samples were analyzed for VOCs, SVOCs, and eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver)

Laboratory analysis of groundwater samples for metals included both total (unfiltered) and soluble (field-filtered) analyses. Suspended sediment was common in most of the groundwater samples because of the very fine-grained nature of the sediments in the screened intervals of the monitoring wells. Groundwater samples for metals were preserved in the field and then later digested in the laboratory with acid. Therefore, the total metal concentration is typically greater than, or equal to, the soluble metal concentration because of the contribution from the fine-grained sediment in the samples. Total metal concentrations may overestimate the concentrations of mobile metals in groundwater.

3.2.2.1 Soil Analyses

Table 3.1 presents the background soil sample analytical results. Arsenic, cadmium, chromium, and lead were reported above the CLP CRDL in selected soil samples. Lead was the only metal that was detected at all three background sites. Arsenic was detected at 3.4 milligrams per kilogram (mg/kg), cadmium at 11.8 mg/kg, chromium at up to 47.9 mg/kg, and lead at up to 36.8 mg/kg.

Methylene chloride was the only target organic compound that was detected above the CLP CRDL. As stated in Section 2.3.2.2, methylene chloride detected in the samples can be attributed to laboratory contamination rather than environmental contamination.

3.2.2.2 Groundwater Analyses

Table 3.2 presents the background groundwater sample results. The monitoring wells were sampled twice, 1 month apart. Total cadmium (one sample), chromium (three samples), and lead (five samples) were detected above the CLP CRDL in the unfiltered groundwater samples and only soluble lead (three samples) equaled or exceeded the CRDL in the filtered groundwater samples. Arsenic was the only metal detected in the soil that was not also detected in the groundwater. Cadmium was detected at 6.6 μg/L, chromium at up to 88 μg/L, lead at up to 36.8 μg/L, and soluble lead at up to 5 μg/L.

Methylene chloride was detected above the CLP CRDL in one of the groundwater samples and is attributable to laboratory and sampling contamination. Additional organic compounds that were detected at or above the CLP CRDL were benzene (one sample), carbon disulfide (two samples), and toluene (one sample). Benzene was detected at 9 μg/L (greater than the MCL of 5 μg/L for benzene),

Table 3.1
Background Soil Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	BKGD-B1 (Site 1)	BKGD-B2 (Site 2)	BKGD-B3 (Site 3)	
		0-2 ft 5/08/91 soil 18521001	4-6 ft 5/16/91 soil 18572004	1-3 ft 5/02/91 soil 18470001	1-3 ft 5/02/91 soil/dup 18470002
VOCs					
methylene chloride (μg/kg)	5				190*
SVOCs					
(none detected > CRDL)					
Metals					
arsenic (mg/kg)	2		3.4		
cadmium (mg/kg)	1		11.8		
chromium (mg/kg)	2		9.8		47.9
lead (mg/kg)	0.6	7.4	36.8	9.8	34.7

Notes:
All soil detection limits do not include a correction for sample moisture.
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
μg/kg: Micrograms per kilogram.
CRDL: Contract required detection limit.
mg/kg: Milligrams per kilogram.
* Methylene chloride attributable to laboratory contamination.

Table 3.2
Background Groundwater Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	MCL	BKGD-MW1 (Site 1)		BKGD-MW2 (Site 2)			BKGD-MW3 (Site 3)	
			5/14/91 water 18551006	6/19/91 water 18794005	5/20/91 water 18589001	6/18/91 water 18785006	6/18/91 water/dup 18785007	5/10/91 water 18539005	6/19/91 water 18794007
VOCs									
benzene ($\mu g/L$)	5	5			9				
carbon disulfide ($\mu g/L$)	5	--		92			160		
methylene chloride ($\mu g/L$)	5								1,100*
toluene ($\mu g/L$)	5	1,000		5					
SVOCs									
(none detected > CRDL)									
Metals									
total cadmium ($\mu g/L$)	5	5						6.6	
total chromium ($\mu g/L$)	10	100				88	59.7		15.1
total lead ($\mu g/L$)	3	50		10.9		36.8	27.4	6.9	8.7
soluble lead ($\mu g/L$)	3	50					3.2	5.0	4.2

Notes:
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
MCL: Maximum contaminant level.
--: No current MCL finalized.
$\mu g/L$: Micrograms per liter.
CRDL: Contract required detection limit.
* Methylene chloride attributable to laboratory contamination.

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carbon disulfide at up to 160 $\mu g/L$, and toluene at 5 $\mu g/L$. The toluene and benzene may indicate residual fuel and/or spent solvent contamination.

Carbon disulfide was detected in the background monitoring wells at Sites 1 and 2 during the second round of groundwater sampling. According to Howard (1987), carbon disulfide may form as a natural product of anaerobic biodegradation. The natural production of carbon disulfide in the vicinity of the Base probably results from the occurrence of broad wetlands associated with Bernard Bayou, Brickyard Bayou, Turkey Creek, and Mississippi Sound. Organic soils also were encountered in most of the borings. Other sources of carbon disulfide include the use of the compounds as a soil fumigant and as a common industrial by-product of manufacturing processes.

3.3 SITE 1: FIRE TRAINING AREA

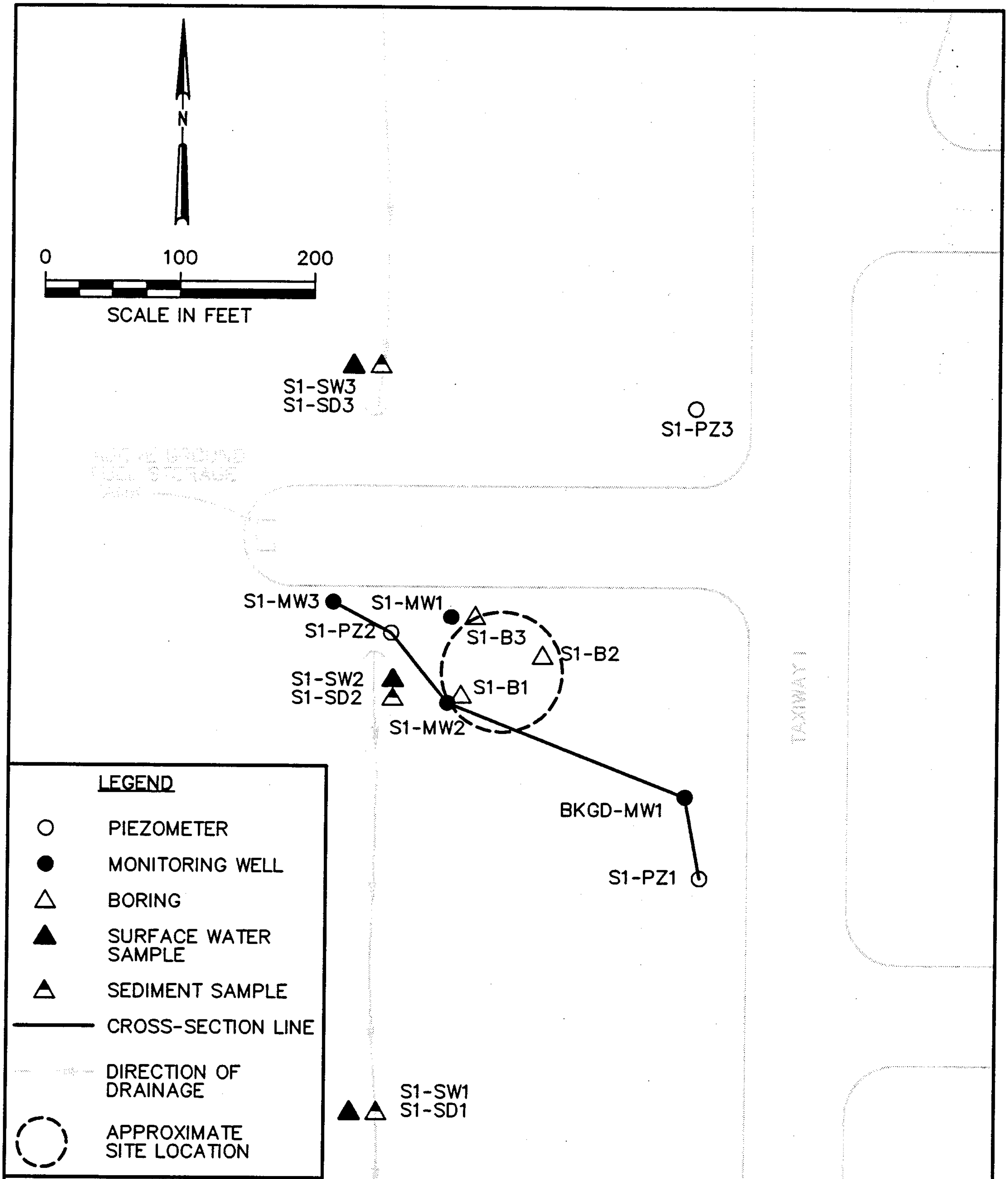
The FTA at Site 1 was known to have been in operation from 1972 (according to the PA, probably in use since 1954) to 1988 and is located west of Runway 13-31 and near Taxiway I on Gulfport-Biloxi Regional Airport land that is leased by the Base. The FTA consists of a flat, unlined, open pit, slightly bermed, with a general depth of 12 to 18 inches to contain the flammable materials used during training. An estimated 27,000 gallons per year of flammable liquids were used at the FTA. Based on a flammable destruction rate of 70 percent, an estimated potential total of 130,000 gallons of waste fuels may have either evaporated or percolated into the ground during the 16-year period this FTA was known to be in use.

3.3.1 Field Investigation

As summarized in Table 2.2, soil and groundwater samples were collected from soil borings and monitoring wells, respectively, at Site 1 in May 1991 to assess the presence of organic and inorganic contaminants in soil and groundwater. Groundwater samples were collected again in June 1991. The locations of sample points at Site 1 are shown on Figure 3.3. Samples were screened in the CSL (Level B), and then selected samples were split and a portion analyzed in the analytical laboratory (Level C) for VOCs, SVOCs, and eight metals. Groundwater samples were analyzed for total (unfiltered) and soluble (field-filtered) metals.

Screening activities included:

- Drilling three soil borings
- Installing three piezometers and measuring the water levels
- Collecting three surface water and three paired depth sediment samples from the drainage ditch



NOTE:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.3
SITE 1 SAMPLE LOCATION MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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Monitoring well locations were selected during confirmatory field activities. The criteria for placement included placing the well on the downgradient side of the site as close as possible to the potential source area (contaminated soils). The location of the source area was evaluated using multiple techniques including visual observations, field monitoring instruments (HNu and OVA), and GC analyses of the soil samples in the CSL.

3.3.2 Screening Results

Figure 3.4 presents a hydrogeologic cross-section that was prepared from the data collected at Site 1. These data consist of geotechnical laboratory results obtained from Shelby tube samples collected below the screened interval and split-spoon samples collected from the screened interval. The cross-section shows organic (humic) soils overlying silty to clayey sand. Water levels in piezometers and monitoring wells are within 2 to 3 feet of land surface.

Figure 3.5 shows the water table and resulting flow directions that were evaluated from groundwater elevation measurements taken from the piezometers and monitoring wells. The figure shows that the water table has a slight gradient that slopes to the west. The confirmatory monitoring well (S1-MW1) location was selected based on piezometer groundwater measurements. The two optional wells (S1-MW2 and S1-MW3) were installed to evaluate contaminant migration in the groundwater downgradient from the site.

The CSL data are presented in Attachment A of Appendix D. All the soil samples, from land surface to 6 feet, indicated the presence of residual fuels. The large number of compounds and high concentrations exceeded the capability of the onsite CSL to accurately identify and quantify individual compounds. Level C analyses confirmed the presence of fuel and solvent contamination.

The groundwater sample from S1-MW1 indicated benzene, ethylbenzene, and total xylenes were present in the CSL analyses. Level C analyses confirmed the presence of the three CSL target compounds. Toluene was not detected above the Level B method detection level but was reported in the Level C sample.

Level B target compounds were not detected in the surface water and sediment samples from the nearby ditch. The Level C analyses confirmed the negative results of the CSL target compounds.

Groundwater flow rates around the FTA can be estimated from values of hydraulic gradient, hydraulic conductivity, and porosity. The hydraulic gradient is measured from the water table map (Figure 3.5) and has been estimated as 0.014 (unitless). Hydraulic conductivity was estimated from slug tests in the background well at Site 1 (BKGD-MW1). The test analyses are presented in Appendix H. Hydraulic conductivity of the surficial aquifer has been estimated as 7.0×10^{-4} centimeters per second. Porosity was estimated as 0.25 (unitless) based on ranges of values from fine

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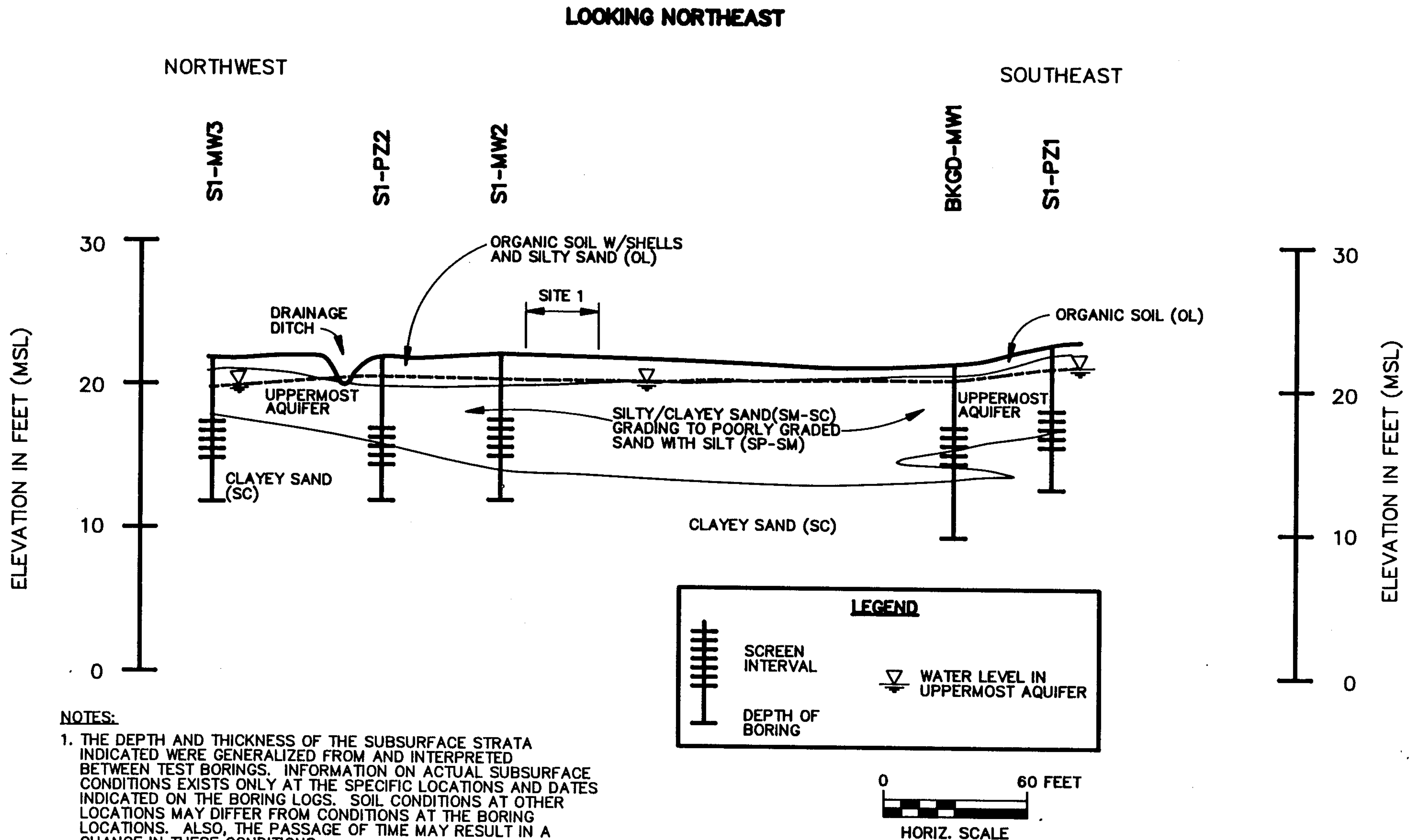

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED WERE GENERALIZED FROM AND INTERPRETED BETWEEN TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED ON THE BORING LOGS. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THESE CONDITIONS.
2. WATER LEVELS WERE MEASURED ON 6/17-18/91
3. MSL - MEAN SEA LEVEL

FIGURE 3.4
HYDROGEOLOGIC CROSS-SECTION THROUGH SITE 1
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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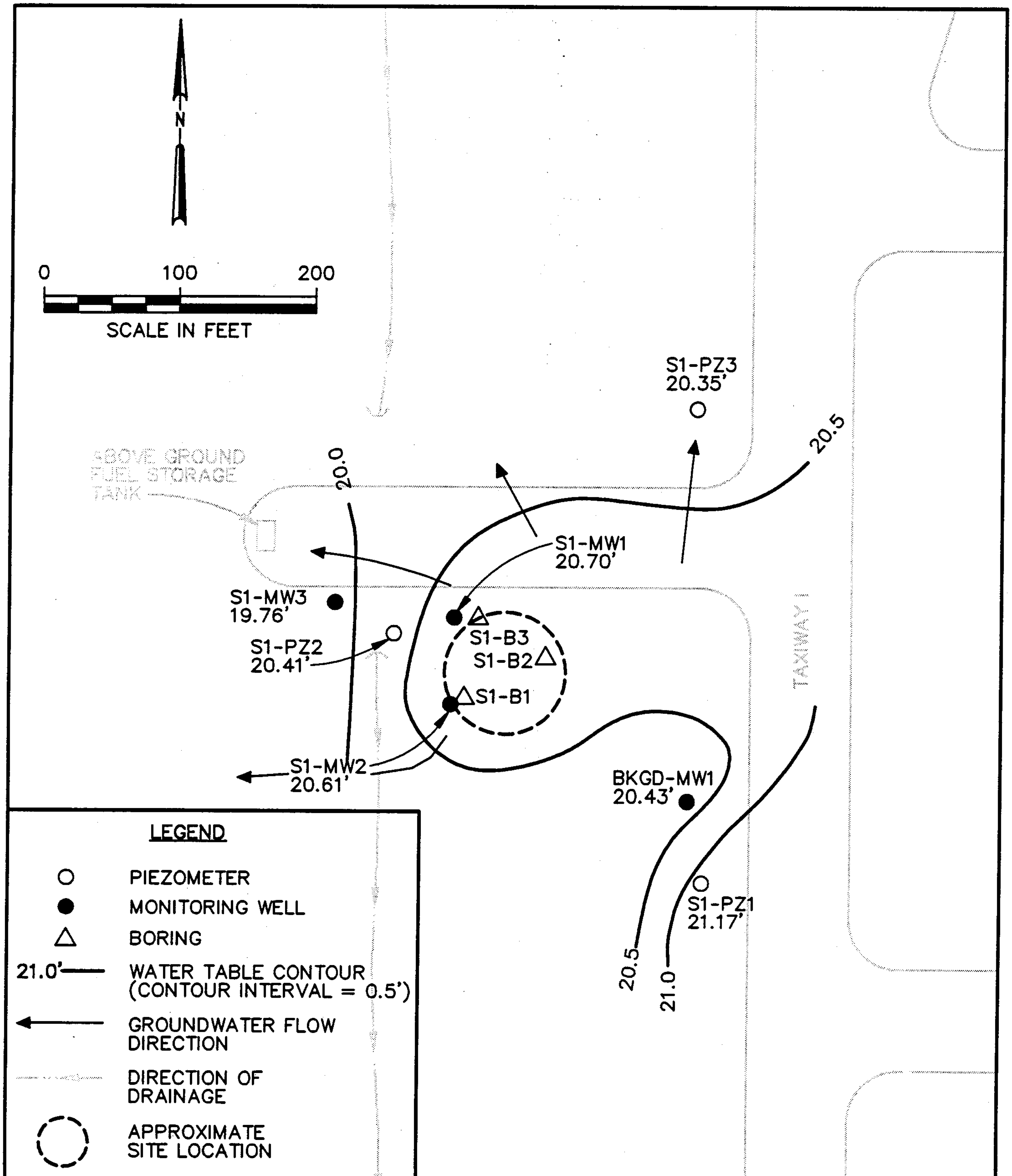

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.5
WATER TABLE MAP OF SITE 1
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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sand aquifers presented in Freeze and Cherry (1979). Using the parameters described above and Darcy's equation ($V=KI/n$), the average linear velocity of groundwater flow around Site 1 is about 40 feet per year.

3.3.3 Confirmatory and Optional Results

The Level C analytical data for Site 1 are presented in Tables 3.3 and 3.4.

3.3.3.1 Soil and Ditch Sediment Analyses

At Site 1, cadmium (five samples), chromium (seven samples), and lead (eight samples), were detected in the soil and sediment at concentrations less than maximum background levels.

Six organic compounds that are indicative of residual fuel and solvent contamination were detected above the CLP CRDL in the shallow soils and sediment at Site 1 (see Figure 3-6). Benzene, ethylbenzene, total xylenes, and three PAHs were detected in soil boring samples from 0 to 6 feet deep. The highest concentration detected was for total xylenes in a 0 to 2-foot deep sample with 56,000 micrograms per kilogram (μg/kg). Concentrations of contaminants are several orders of magnitude lower in the 4 to 6-foot sample in the FTA than in the shallower samples. Fluoranthene was detected at 680 μg/kg in one of the sediment samples collected from the drainage ditch adjacent to the FTA. An occasional laboratory contaminant, 2-butanone, was detected in one sample.

3.3.3.2 Surface Water and Groundwater Analyses

Cadmium and lead were detected above the CLP CRDL in the surface water samples. Cadmium was detected in one sample at 6.4 μg/L and lead was detected in two samples at up to 46.6 μg/L. Five metals--barium, cadmium, chromium, lead, and silver--were detected in the unfiltered groundwater samples from Site 1 (see Figure 3-7). Soluble barium, soluble cadmium, and soluble lead also were detected in the filtered samples. Metals in unfiltered samples are commonly associated with fine-grained aquifers. These results indicate that metals are present in the form of particulates as well as dissolved in the water. Cadmium and soluble cadmium at 5.1 μg/L each were the only metal concentrations detected in the groundwater samples that exceeded the MCLs for drinking water.

Four target organic compounds--benzene, carbon disulfide, toluene, and total xylenes--were detected at or above the CLP CRDL in the groundwater at Site 1. Carbon disulfide was the only target organic compound that was detected in the surface water and may be a naturally occurring biodegradation product. The remaining compounds are indicative of residual fuel contamination. Benzene, toluene, and total xylenes were detected in monitoring well S1-MW1, only toluene was detected in monitoring well S1-MW2. Carbon disulfide was detected in S1-MW2 and S1-MW3.

Table 3.3
Site 1: FTA Soil and Sediment Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	Maximum Background Concentration	S1-SD2		S1-SD3		S1-B1	S1-B2		S1-B3
			0-6 in. 5/07/91 sediment 18505001	30-36 in. 5/07/91 sediment 18505002	0-6 in. 5/07/91 sediment 18505003	30-36 in. 5/07/91 sediment 18505004	2-4 ft. 5/07/91 soil 18505005	0-2 ft. 5/07/91 soil 18505006	0-2 ft. 5/07/91 soil/dup 18505007	4-6 ft. 5/07/91 soil 18505008
VOCs benzene (μg/kg)	5	ND					560			9
2-butanone (μg/kg)	10	ND		14						
ethylbenzene (μg/kg)	5	ND					310	4,400	2,200	
total xylenes (μg/kg)	5	ND					490	56,000	28,000	35
SVOCs fluoranthene (μg/kg)	330	ND			680					
2-methylnaphthalene (μg/kg)	330	ND					1,100	22,000	23,000	
naphthalene (μg/kg)	330	ND						6,600	8,600	560
Metals total cadmium (mg/kg)	1	11.8		2.2			1.5	2.9	1.4	5.8
total chromium (mg/kg)	2	47.9	4.4	4.4	9.7	2.8	4.4	4.4		3.6
total lead (mg/kg)	0.6	36.8		12.1	12.3	6.0	24.0	15.6	6.9	15.1

Notes:
All soil detection limits do not include a correction for sample moisture.
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
ND: Not detected in the background sample above the CRDL.

Table 3.4
Site 1: FTA Groundwater and Surface Water Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	MCL	Maximum Background Concentration	S1-SW2		S1-SW3	S1-MW1			S1-MW2		S1-MW3	
				5/07/91 water 18505010	5/07/91 water/dup 18505011	5/20/91 water 18505012	5/15/91 water 18560001	6/19/91 water 18794001	6/19/91 water/dup 18794002	5/16/91 water 18572001	6/19/91 water 18794003	5/14/91 water 18551005	6/19/91 water 18794004
VOCs benzene ($\mu g/L$)	5	5	9				470	440	400				
carbon disulfide ($\mu g/L$)	5	--	160		60	8					14		5
toluene ($\mu g/L$)	5	1,000	5							6			
total xylenes ($\mu g/L$)	5	10,000	ND				33						
SVOCs none detected > CRDL													
Metals total barium ($\mu g/L$)	200	1,000	ND				212	245	210				
soluble barium ($\mu g/L$)	200	1,000	ND				212						
total cadmium ($\mu g/L$)	5	5	6.6	6.4			5.1						
soluble cadmium ($\mu g/L$)	5	5	ND				5.1						
total chromium ($\mu g/L$)	10	100	88					22.4	48.3	12.4	17.0		29.7
total lead ($\mu g/L$)	3	50	36.8		6.9	46.6		11.6	19.5	43.6	15.0		24.4
soluble lead ($\mu g/L$)	3	50	ND				4.7		9.4		7.6	3.7	
total silver ($\mu g/L$)	10		ND					10.5					

Notes:
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
MCL: Maximum Contaminant Level
--: No MCL finalized
ND: Not detected in the background sample above the CRDL.

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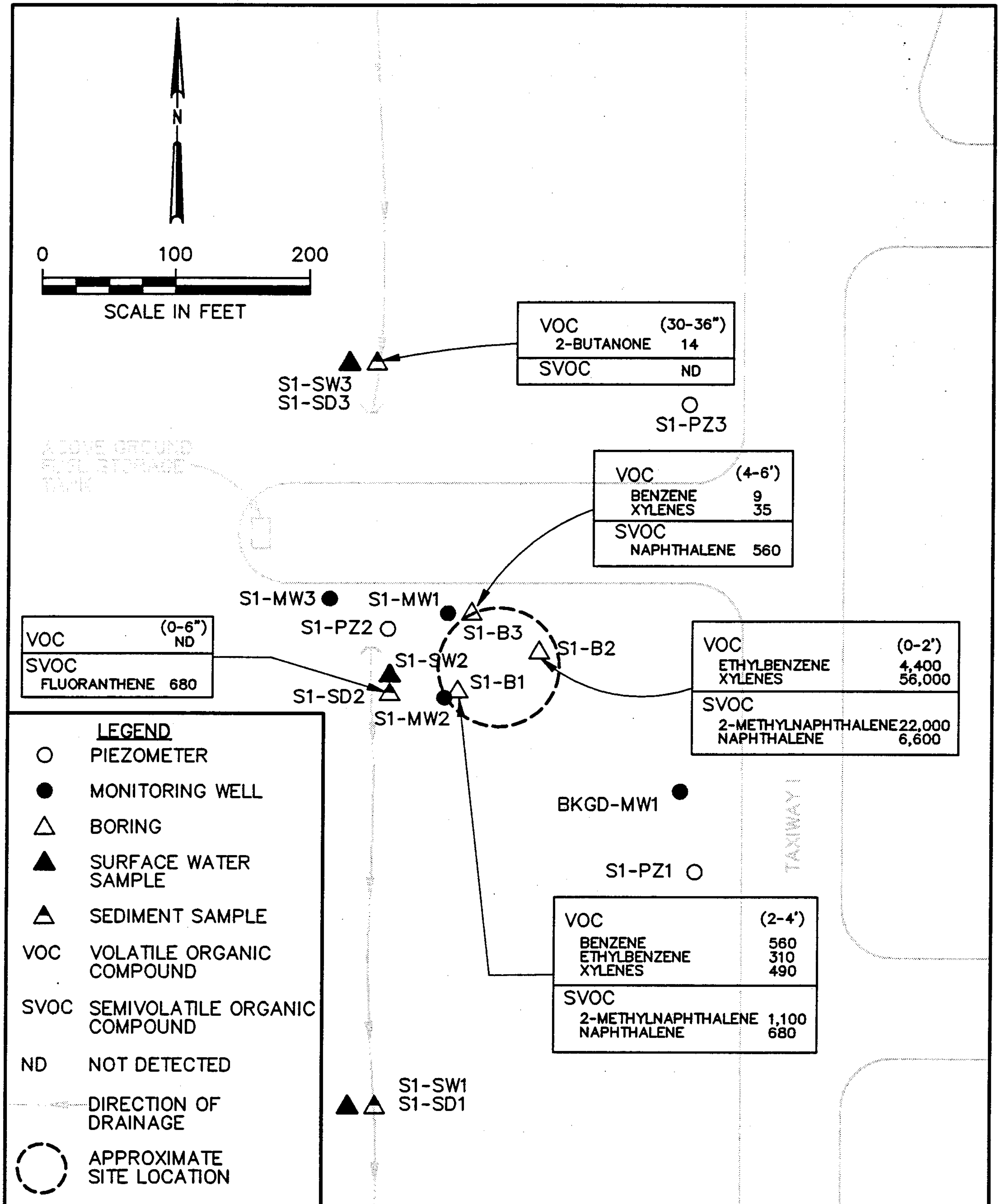

NOTE:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.
2. ALL CONCENTRATIONS REPORTED IN µg/kg (ppb).

FIGURE 3.6
ORGANIC COMPOUNDS IN SOIL AND DITCH SEDIMENT AT SITE 1
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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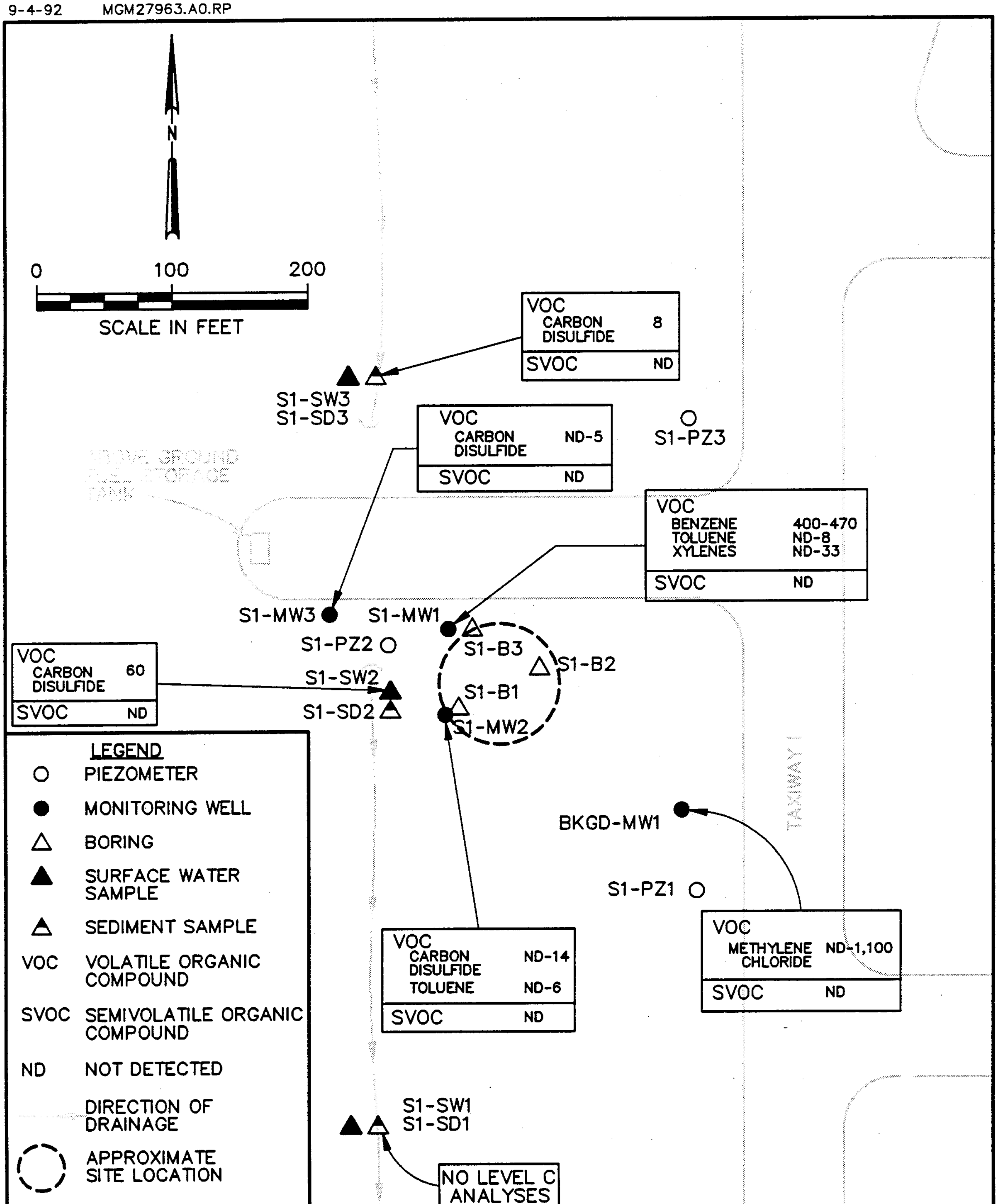

NOTE:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.
2. RANGE REPRESENTS TWO SAMPLING EVENTS. MAY - JUNE 1991.
3. ALL CONCENTRATIONS REPORTED IN µg/l (ppb).

FIGURE 3.7
ORGANIC COMPOUNDS IN SURFACE WATER AND GROUNDWATER AT SITE 1
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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3.4 SITE 2: JP-4 BULK STORAGE AREA, MILL ROAD

The JP-4 bulk storage site located on leased property between Bernard Bayou and Mill Road, housed two 25,000-gallon above-ground AVGAS tanks from 1943 to 1974 and one 440,000 gallon JP-4 above-ground tank from 1973 to the present. From past tank cleaning operation, an estimated 19,700 gallons of AVGAS-contaminated water and 5,500 gallons of JP-4-contaminated water may have been released at this site. Additionally, a 2,000-gallon AVGAS spill occurred at this facility in the mid-1960s.

3.4.1 Field Investigation

As summarized in Table 2.2, soil and groundwater samples were collected from soil borings and monitoring wells, respectively, at Site 2 in May 1991 to assess the presence of organic and inorganic contaminants in soil and groundwater. Groundwater samples were collected again in June 1991. The location of sample points at Site 2 are shown on Figure 3.8. Samples were screened in the CSL (Level B) and then selected samples were split and a portion was analyzed in the analytical laboratory (Level C) for VOCs, SVOCs, and eight metals. Groundwater samples were analyzed for total (unfiltered) and soluble (field filtered) leads (Level C).

Screening activities included:

- Conducting a GPS and soil gas survey
- Drilling nine soil borings
- Installing five piezometers and measuring the water levels

Monitoring well locations were selected during field activities. The criteria for monitoring well placement included an evaluation of the GPS and soil gas survey results, an evaluation of the piezometer water level measurements, and positioning the well on the downgradient side of the site and as close as possible to the source areas (contaminated soils). The location of potential source areas was evaluated using techniques such as visual observations, field monitoring instruments (HNu and OVA) and GC analyses of the soil samples in the CSL.

3.4.2 Screening Results

Figure 3.9 presents a hydrogeologic cross-section that was prepared from the data collected at Site 2. The figure shows that the strata penetrated by the SI borings, piezometers, and monitoring wells are predominantly sand. The cross-section shows that a surficial silt bed occurs at those points close to the bayou. Water levels in the piezometers and monitoring wells show the water table is consistently 3 to 4 feet below land surface across the site.

Figure 3.10 shows a water table map of the site. The map shows a gradient sloping towards the bayou. Groundwater flow directions as interpreted from the water table map show flow towards and discharging to the bayou. Comparison of the water table

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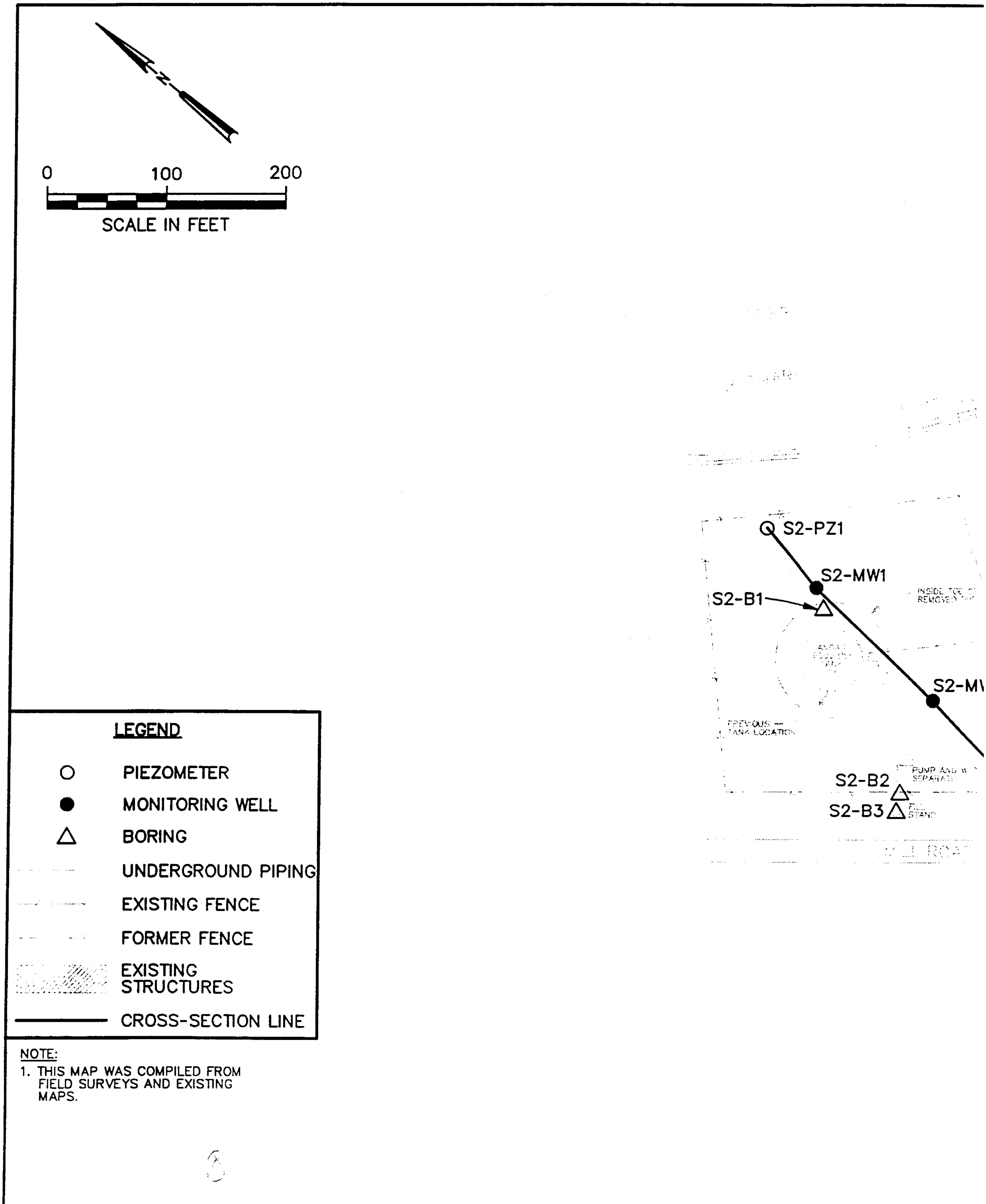

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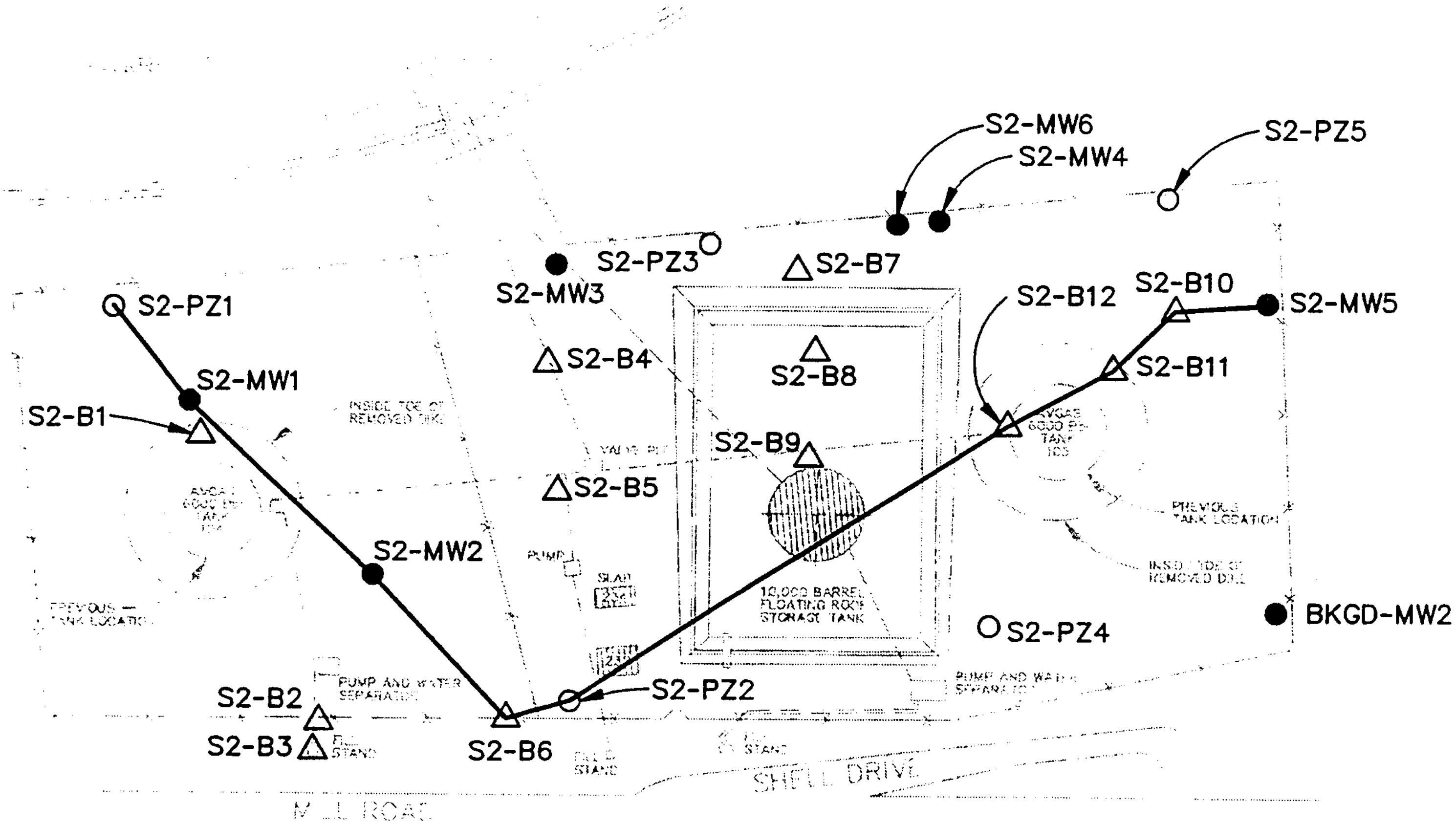

SITE 2 SAMPLE LO
GULFPORT FIELD TR
Gulfport

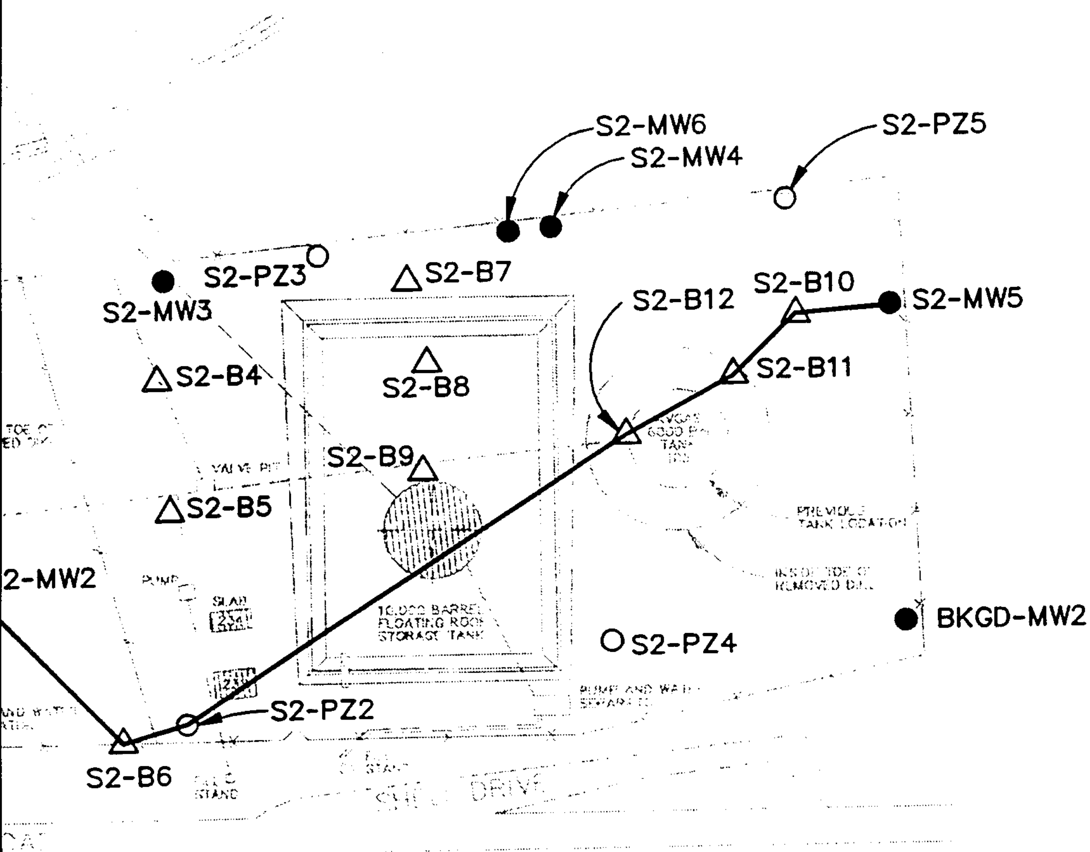

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FIGURE 3.8
SITE 2 SAMPLE LOCATION MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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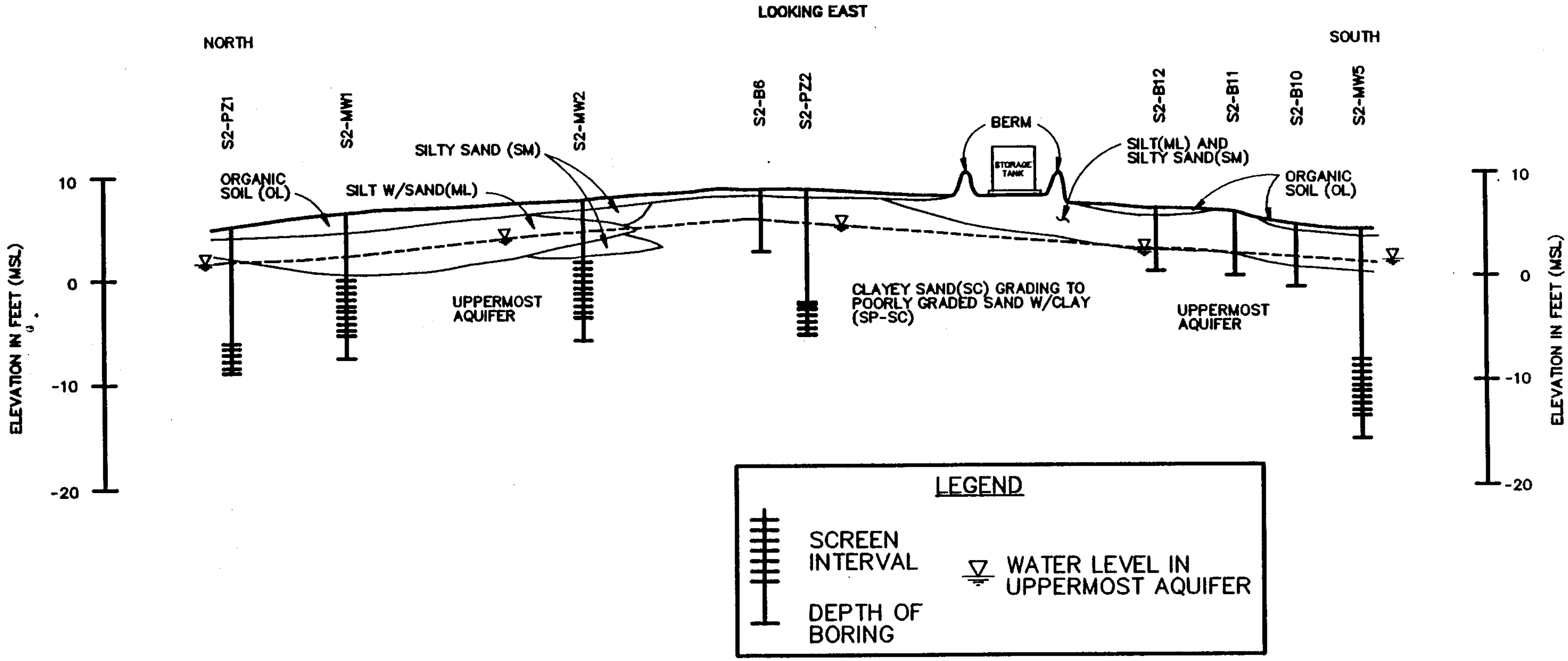

0 60 FEET

HORIZ. SCALE

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED WERE GENERALIZED FROM AND INTERPRETED BETWEEN TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED ON THE BORING LOGS. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THESE CONDITIONS.
2. WATER LEVELS WERE MEASURED ON 6/17-18/91
3. MSL - MEAN SEA LEVEL

FIGURE 3.9
HYDROGEOLOGIC CROSS-SECTION THROUGH SITE 2
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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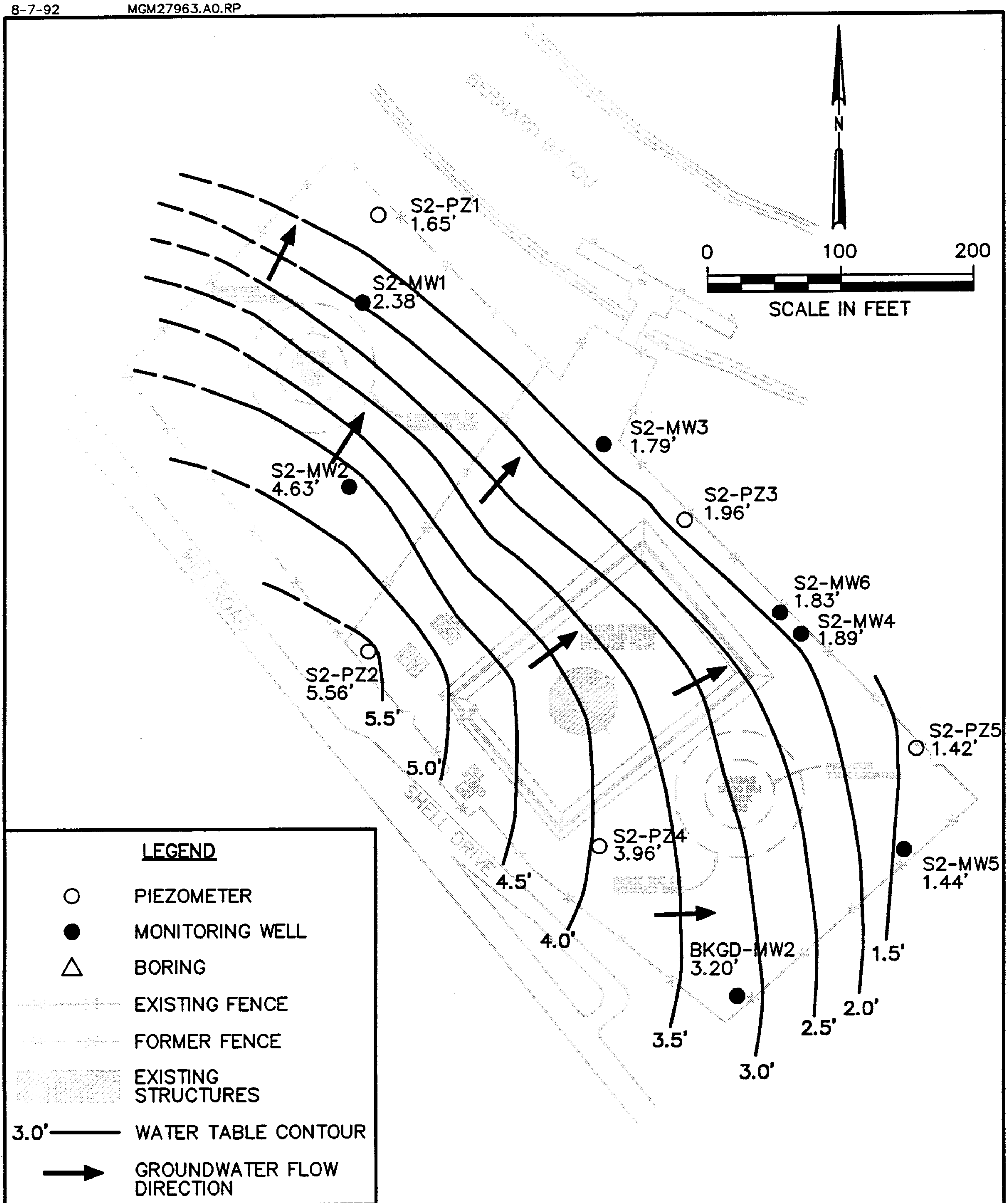

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.10
WATER TABLE MAP OF SITE 2
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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map and the cross-section indicates that the absence of the surficial silt bed at S2-PZ2 results in recharge to the surficial aquifer. The water level at S2-PZ2 is about 4 feet higher than water levels in wells and piezometers adjacent to the bayou.

A groundwater flow rate was estimated as explained for Site 1 using Darcy's Law (V=KI/n). The following parameters were used:

I	=	Hydraulic gradient = 0.016 (unitless)
K	=	Hydraulic conductivity = 6.8 x 10^{-4} centimeters per second
n	=	Porosity = 0.25 (unitless)

Using the parameters above, the average linear velocity is almost 45 feet per year. Using a flow rate of 45 feet per year, the travel time from S2-PZ2 to the bayou (315 feet) is about 7 years.

Figures 3.11 and 3.12 show the results of the GPS and soil gas surveys at Site 2. Soil gas probes were attempted at 63 locations, of which, 43 gas samples were collected. Groundwater probes were attempted at 49 locations, of which, 38 samples were collected. The figures show contours of equal concentration of total hydrocarbons as measured by analytical methods using an onsite flame ionizing detector (FID) GC. These figures show widespread distribution of organic compounds in both groundwater and soil gas. In a high water table environment the organics present in soil gas are usually the result of volatilization from the groundwater except for small areas of heavy soil contamination.

These figures show that groundwater contaminants may be migrating offsite. The data also indicate a number of potential source areas including previous and existing tank containment areas, underground piping, and a previous fill area located on Mill Road in the area around S2-B2. The GPS and soil gas survey results are presented in Appendix F.

The CSL analyzed soil and groundwater samples from Site 2. The CSL data are presented in Appendix D. Many soil samples to a depth of 4 feet indicated the presence of residual fuels. The large number of compounds and high concentrations exceeded the capability of the onsite laboratory to accurately identify and quantify individual compounds. Six borings (B2, B4, B5, B7, B8, and B9) had much higher levels of contamination than the other borings. Boring S2-B2 is near the previous location of a truck fill stand and may have been the site of a recorded spill event. Borings S2-B4 and S2-B5 are near underground piping that may have leaked. Borings S2-B7, S2-B8, and S2-B9 are inside or adjacent to the containment area of the existing tank.

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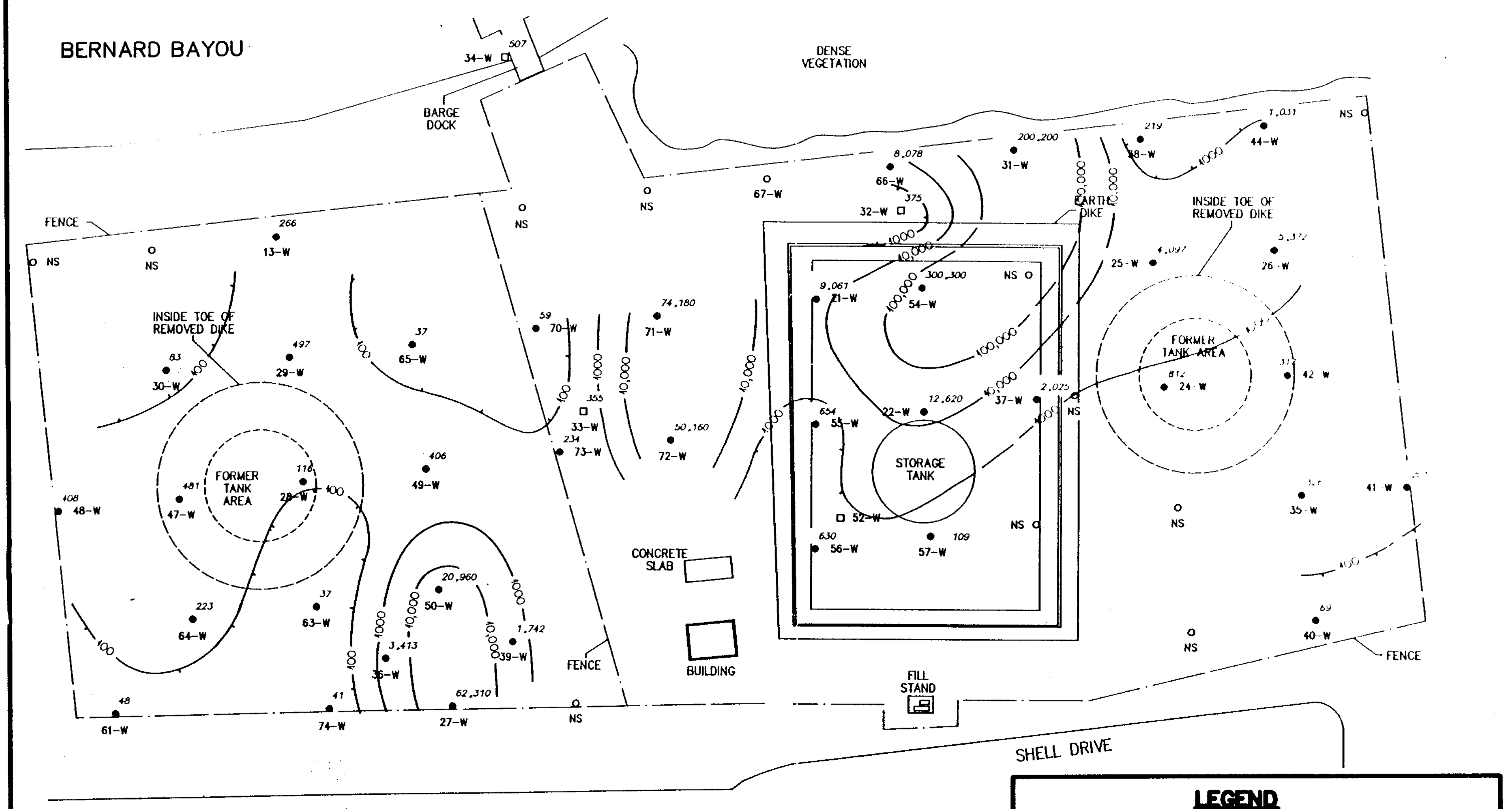

SOURCE:

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

LEGEND

- ● GROUNDWATER SAMPLE LOCATION
- ○ NS-NOT SAMPLED (UNCOLLECTABLE)
- □ SURFACE WATER SAMPLE LOCATION

FIGURE 3.11
SCREENING RESULTS SHOWING TOTAL VOCS (ppb) IN SHALLOW GROUNDWATER
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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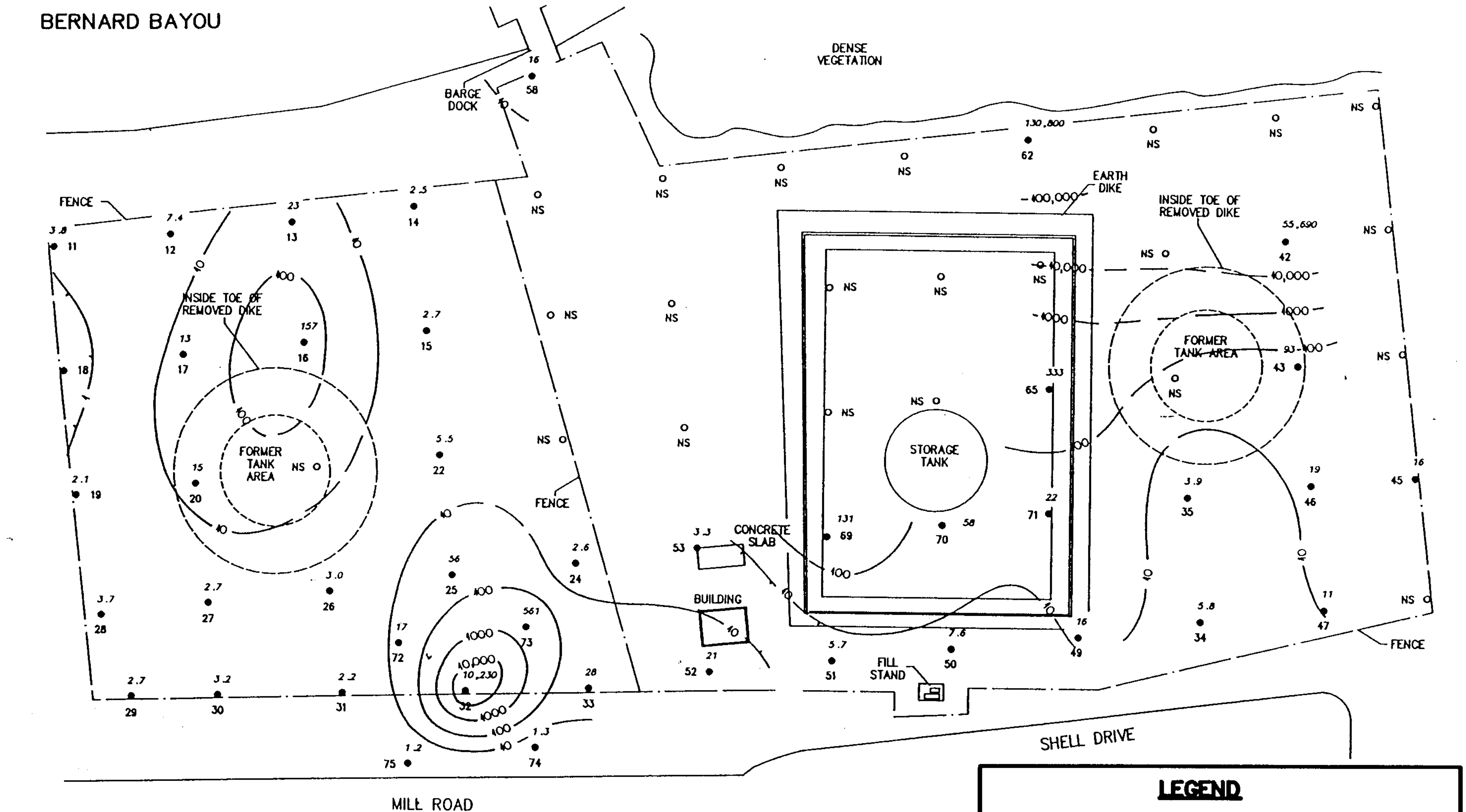

SOURCE:

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

LEGEND

● SOIL GAS SAMPLE LOCATION

○ NS-NOT SAMPLED (UNCOLLECTABLE)

FIGURE 3.12
SCREENING RESULTS SHOWING VOCS (ppb) IN SOIL GAS
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

CH2M HILL

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3.4.3 Confirmatory and Optional Results

The Level C analytical data for soil and groundwater samples at Site 2 are presented in Tables 3.5 and 3.6. The locations of the soil and groundwater samples are shown in Figures 3.13 and 3.14, respectively.

3.4.3.1 Soil Results

At Site 2, barium, cadmium, chromium, and lead were detected above the CLP CRDL. Barium and lead were detected above the background soil sample concentrations. Cadmium was detected in five samples at up to 4.3 mg/kg which was below the background concentration of 11.8 mg/kg. Barium was detected in one sample at 50 mg/kg, however, barium was not detected in the background sample. Chromium was detected above the CLP CRDL in all 14 soil samples at concentrations ranging from 3.4 to 25 mg/kg. The maximum background concentration for chromium was 47.9 mg/kg. Lead was detected in all 14 soil samples at up to 153 mg/kg. Two samples contained lead at concentrations greater than the background maximum concentration of 36.8 mg/kg. The USGS reports background lead concentrations of up to 300 mg/kg in the eastern United States.

Acetone and 2-butanone were detected in selected samples. These compounds can be attributed to laboratory contamination.

Additionally, other target VOCs and SVOCs were detected above background and CLP CRDL concentrations in the shallow soils (2-6 feet) at Site 2. These compounds are indicative of residual fuel and/or solvent contamination. The highest VOC and SVOC concentrations were for total xylenes at 11,000 μg/kg and fluoranthene at 460 μg/kg, respectively.

3.4.3.2 Groundwater Results

Lead was detected above the CLP CRDL in all six of the monitoring wells (both sampling rounds, except for well S2-MW5) at Site 2, in the unfiltered samples. Two of the unfiltered samples contained lead concentrations (51.1 and 39.7 μg/L) greater than the background maximum of 36.8 μg/L in groundwater. Metals in unfiltered samples commonly come from fine-grained aquifers. Five of the filtered groundwater samples that were analyzed at Site 2 contained soluble lead at up to 34 μg/L, above the maximum background concentration of 3 μg/L. The current MCL for lead is 50 μg/L, however, in December 1992, the action level for lead in drinking water will be reduced to 15 μg/L.

The common field and laboratory contaminants bis(2-ethylhexyl) phthalate and methylene chloride were detected above CLP CRDL in selected groundwater samples. Carbon disulfide was detected in all samples but two, and can be attributed the result of natural anaerobic biodegradation processes.

Table 3.5
Site 2: JP-4 Bulk Storage Area Soil Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	Maximum Background Concentration	S2-B1	S2-B2	S2-B3		S2-B4	S2-B5	S2-B6
			2-4 ft 5/15/91 soil 18560007	4-6 ft 5/15/91 soil 18560008	4-6 ft 5/15/91 soil 18560012	4-6 ft 5/15/91 soil/dup 18560013	2-4 ft 5/15/91 soil 18560005	4-6 ft 5/15/91 soil 18560006	2-4 ft 5/15/91 soil 18560014
VOCs									
acetone (μg/kg)	10	ND			150*	1,100*			
benzene (μg/kg)	5	ND		42	12				
2-butanone (μg/kg)	10	ND				64*	13*		
ethylbenzene (μg/kg)	5	ND		1,300	190	350		5,100	
toluene (μg/kg)	5	ND				180			
total xylenes (μg/kg)	5	ND		2,600	290	1,800		11,000	
SVOCs									
fluoranthene (μg/kg)	330	ND						460	
phenanthrene (μg/kg)	330	ND						450	
pyrene (μg/kg)	330	ND						440	
METALS									
total cadmium (mg/kg)	1	11.8	1.9				1.7	4.3	1.5
total chromium (mg/kg)	2	47.9	11.9	6.8	7.6	9.0	15.0	7.5	14.0
total lead (mg/kg)	0.6	36.8	153	23.1	9.3	14.5	24.8	10.2	10.9

Notes:
All soil detection limits do not include a correction for sample moisture.
Eight digit number in sample description is the laboratory report reference.
There are no MCLs for soils.
Blanks indicate value reported less than CRDL.
ND: Not detected in the background sample above CRDL.
*: Acetone and 2-butanone attributable to laboratory contamination.
CRDL: Contract required detection limit.

dup: Duplicate.
μg/kg: Micrograms per kilogram.
mg/kg: Milligrams per kilogram.

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Table 3.5 (Cont'd)
Site 2: JP-4 Bulk Storage Area Soil Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	Maximum Background Concentration	S2-B7		S2-B8	S2-B9	S2-B10	S2-B11	S2-B12
			2-4 ft 5/14/91 soil 18551001	2-4 ft 5/14/91 soil/dup 18551002	2-4 ft 5/16/91 soil 18572005	2-4 ft 5/16/91 soil 18572006	2-4 ft 5/15/91 soil 18560002	4-6 ft 5/15/91 soil 1856003	2-4 ft 5/15/91 soil 18560004
VOCs acetone (μg/kg)	10	ND				1,100*			
methylene chloride (μg/kg)	5	190*			210*	140*			
SVOCs (none detected > CRDL)									
METALS barium (mg/kg)	40	ND		50					
total cadmium (mg/kg)	1	11.8				1.3			
total chromium (mg/kg)	2	47.9	3.4	3.9	21.7	25.0	7.2	9.7	7.5
total lead (mg/kg)	0.6	36.8	7.6	133	19.5	9.6	29.9	34.1	19.7

Notes:
All soil detection limits do not include a correction for sample moisture.
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
ND: Not detected in the background sample above CRDL.
*: Acetone and methylene chloride attributable to laboratory contamination.
CRDL: Contract required detection limit.
dup: Duplicate.
μg/kg: Micrograms per kilograms.
mg/kg: Milligrams per kilogram.

Table 3.6
Site 2: JP-4 Bulk Storage Area Groundwater Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	MCL	Maximum Background Concentration	S2-MW1		S2-MW2		S2-MW3	
				5/20/91 water 18598003	6/17/91 water 18771001	5/22/91 water 18605003	6/17/91 water 18771002	5/20/91 water 18598002	6/18/91 water 18785001
VOCs									
benzene (µg/L)	5	5	9			200	160	170	55
carbon disulfide (µg/L)	5	--	160	9	7		43	51	45
ethylbenzene (µg/L)	5	°700	ND			110	47	25	7
ethylene dibromide (µg/L)	0.02	0.05	ND	0.18	0.11	0.062	0.65	0.48	0.20
methylene chloride (µg/L)	5	--	1,100		690*				
toluene (µg/L)	5	1,000	5				19		
total xylenes (µg/L)	5	10,000	ND			300	100	5	
SVOCs									
bis(2-ethylhexyl)phthalate (µg/L)	10	--	ND		22				
METALS									
total lead (µg/L)	3	50	36.8	6.3	19.9	39.7	51.1	6.7	24.2
soluble lead (µg/L)	3	50	5.0		4.5		16.4		3.3

Notes:
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
--: No MCL finalized.
CRDL: Contract required detection limit.
MCL: Maximum contaminant level.
µg/L: Micrograms per liter.
ND: Not detected in the background sample above CRDL.
*: Methylene chloride attributable to laboratory contamination.

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Table 3.6 (Cont'd)
Site 2: JP-4 Bulk Storage Area Groundwater Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	MCL	Maximum Background Concentration	S2-MW4		S2-MW5		S2-MW6		
				5/21/91 water 18598001	6/18/91 water 18785002	5/20/91 water 18589002	6/18/91 water 18785003	5/22/91 water 18605001	5/22/91 water/dup 18605002	6/18/91 water 18785004
VOCs										
benzene ($\mu g/L$)	5	5	9	110	100	7	23			9
carbon disulfide ($\mu g/L$)	5	--	160	14	93	56	180		9	10
methylene chloride ($\mu g/L$)	5	--	1,100		620*					
toluene ($\mu g/L$)	5	1,000	5		6	8				
total xylenes ($\mu g/L$)	5	10,000	ND					5	5	5
SVOCs (none detected > CRDL)										
METALS										
total lead ($\mu g/L$)	3	50	36.8	14.7	23.0		24.0	16.4	8.9	14.1
soluble lead ($\mu g/L$)	3	50	3		4.8					34.0

Notes:
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
--: No MCL finalized.
CRDL: Contract required detection limit.
MCL: Maximum contaminant level.
$\mu g/L$: Micrograms per liter.
ND: Not detected in the background sample above CRDL.
*: Methylene chloride attributable to laboratory contamination.

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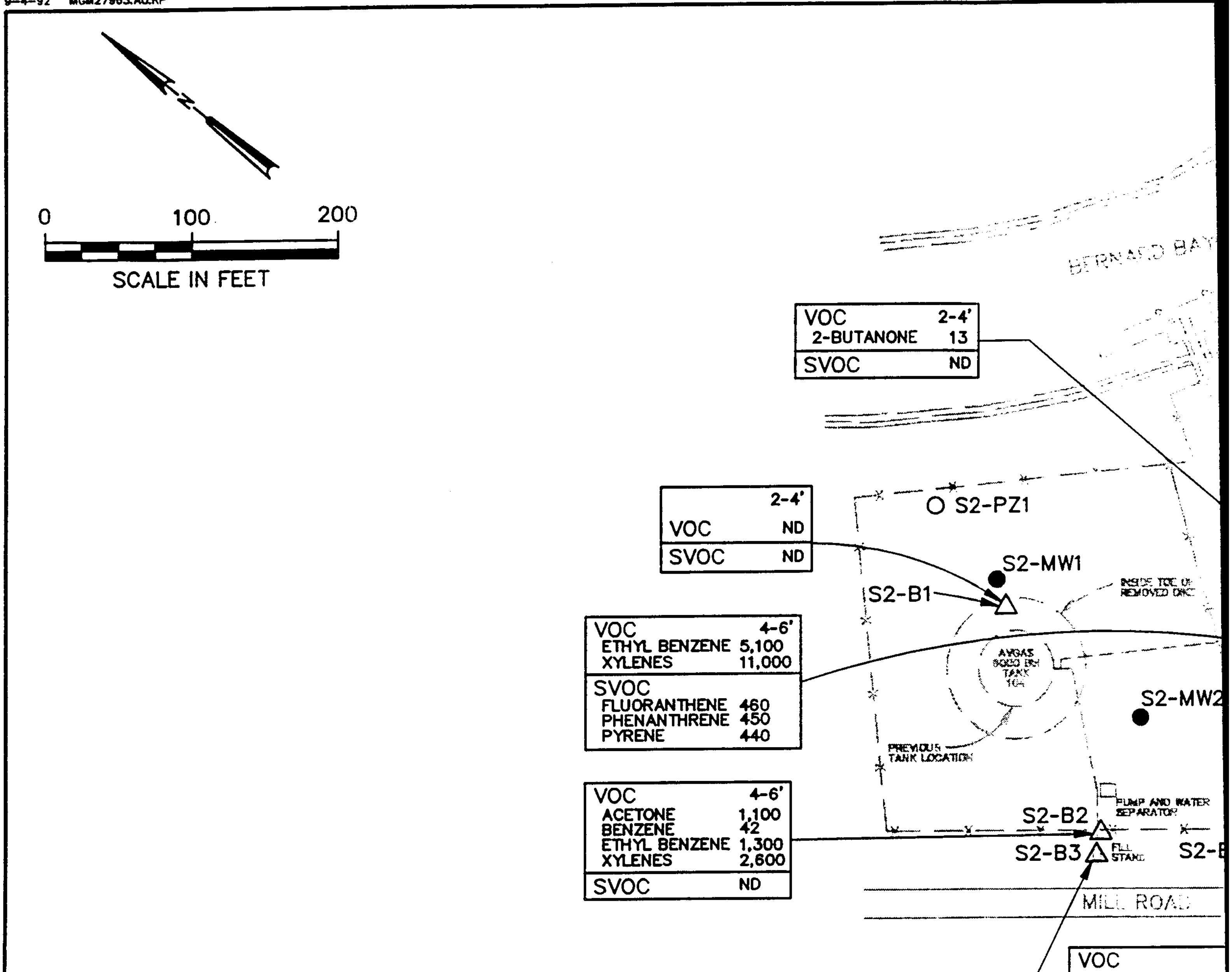

LEGEND

○	PIEZOMETER		FORMER FENCE
●	MONITORING WELL		EXISTING STRUCTURES
△	BORING		
	UNDERGROUND PIPING	VOC - VOLATILE ORGANIC COMPOUND	
	EXISTING FENCE	SVOC - SEMIVOLATILE ORGANIC COMPOUND	
		ND - NOT DETECTED	

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.
2. ALL CONCENTRATIONS GIVEN IN µg/kg (ppb).

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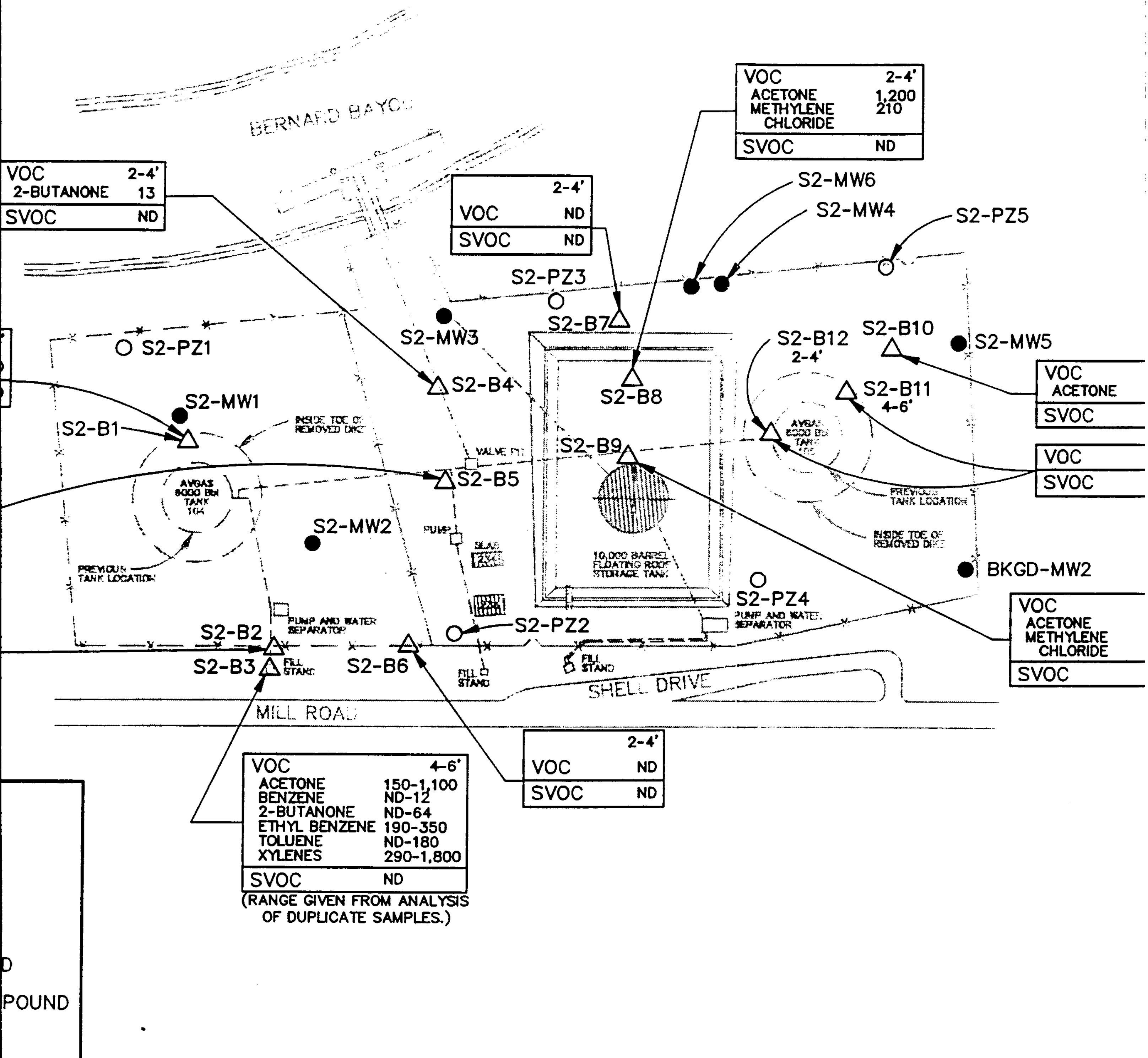

ORGANIC COMPOUNDS IN
GULFPORT FIEL
Gulf

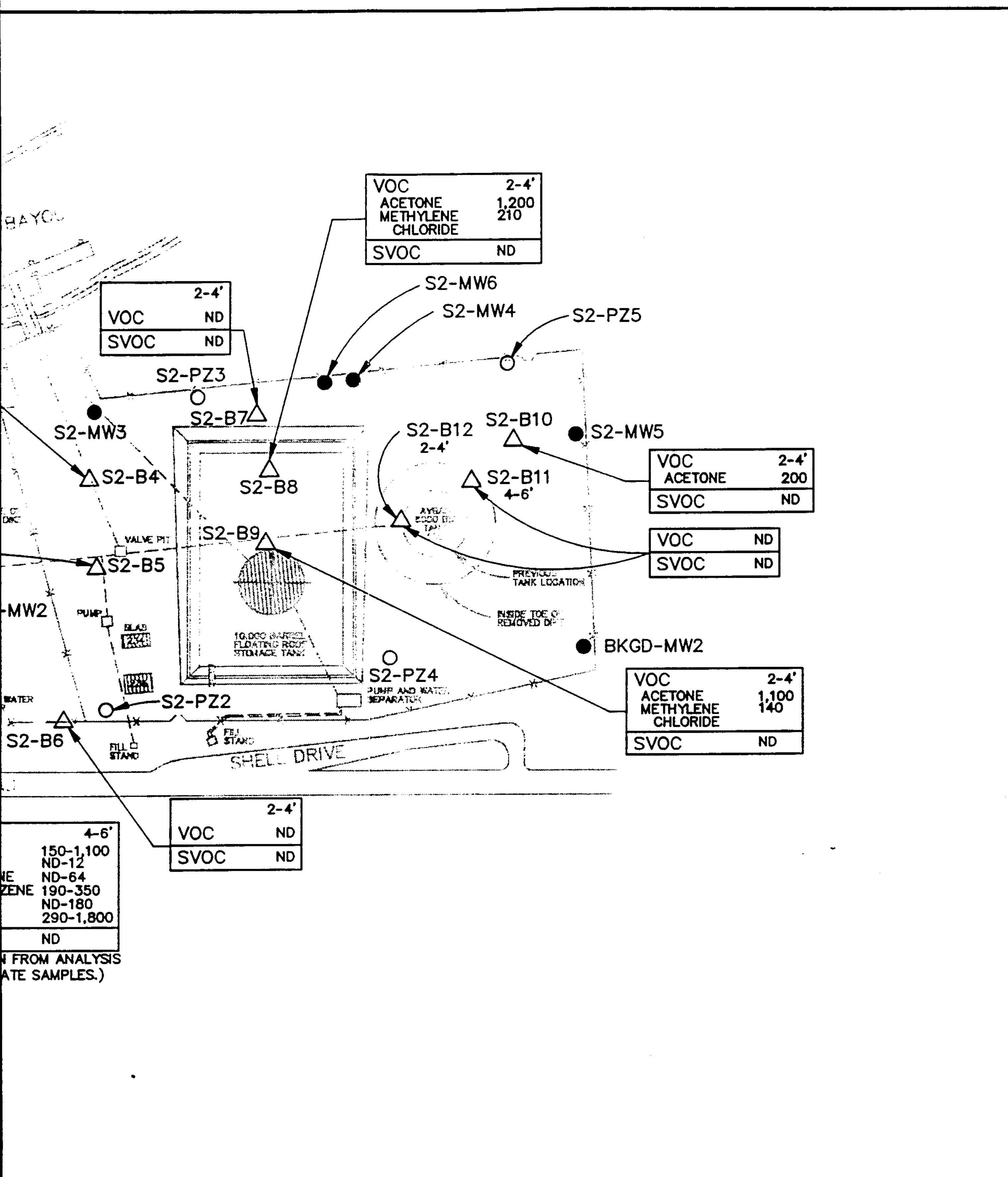

FIGURE 3.13
ORGANIC COMPOUNDS IN SOIL AT SITE 2
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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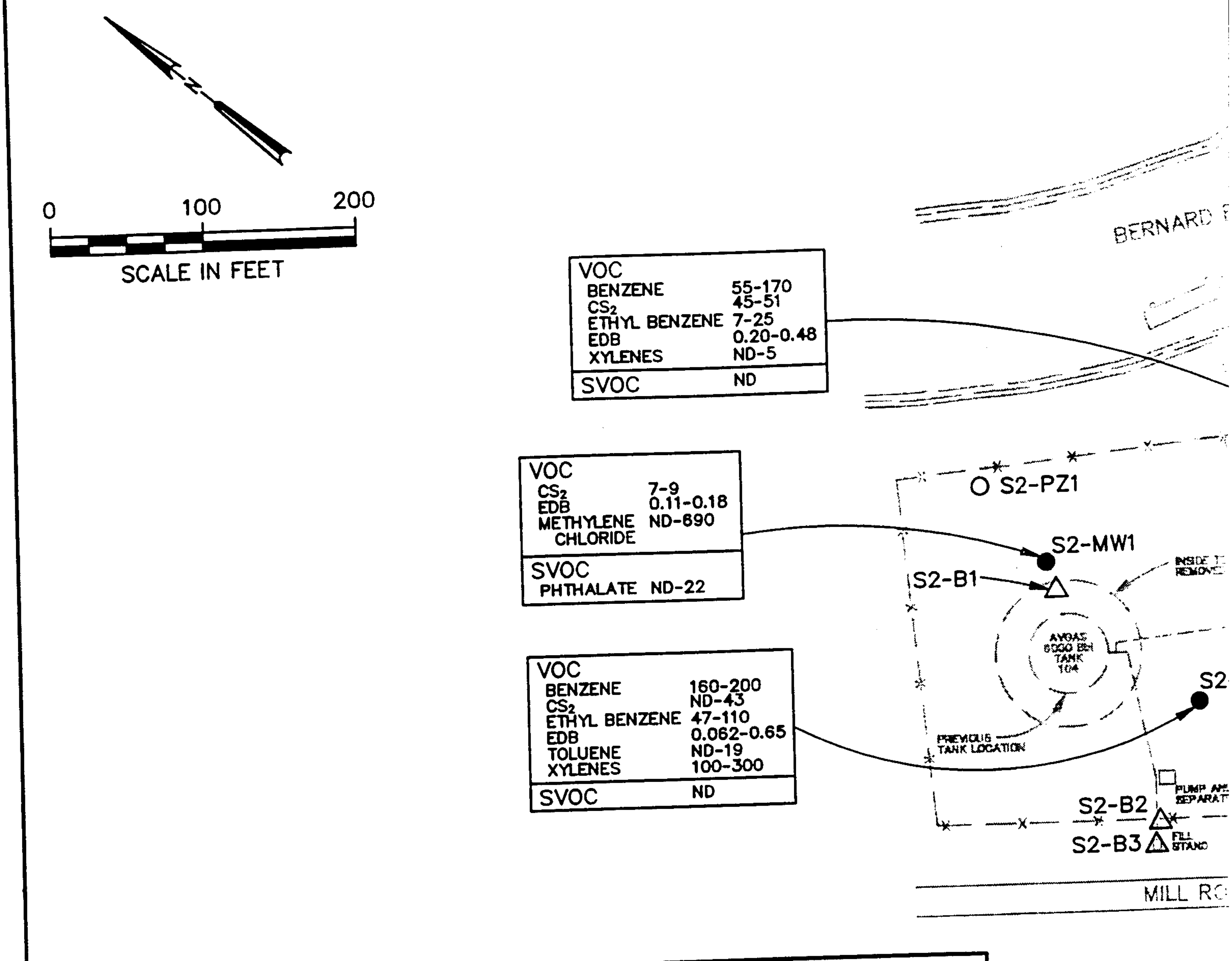

LEGEND

○	PIEZOMETER	VOC - VOLATILE ORGANIC COMPOUND
●	MONITORING WELL	SVOC - SEMIVOLATILE ORGANIC COMPOUND
△	BORING	ND - NOT DETECTED
	UNDERGROUND PIPING	CS_2 - CARBON DISULFIDE
	EXISTING FENCE	EDB - ETHYLENE DIBROMIDE
	FORMER FENCE	PHTHALATE - BIS(2-ETHYLHEXYL) PHTHALATE
	EXISTING STRUCTURES	

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.
2. ALL CONCENTRATIONS GIVEN IN $\mu g/l$ (ppb).
3. RANGE OF VALUES REPRESENTS TWO SAMPLING EVENTS, MAY-JUNE 1991.

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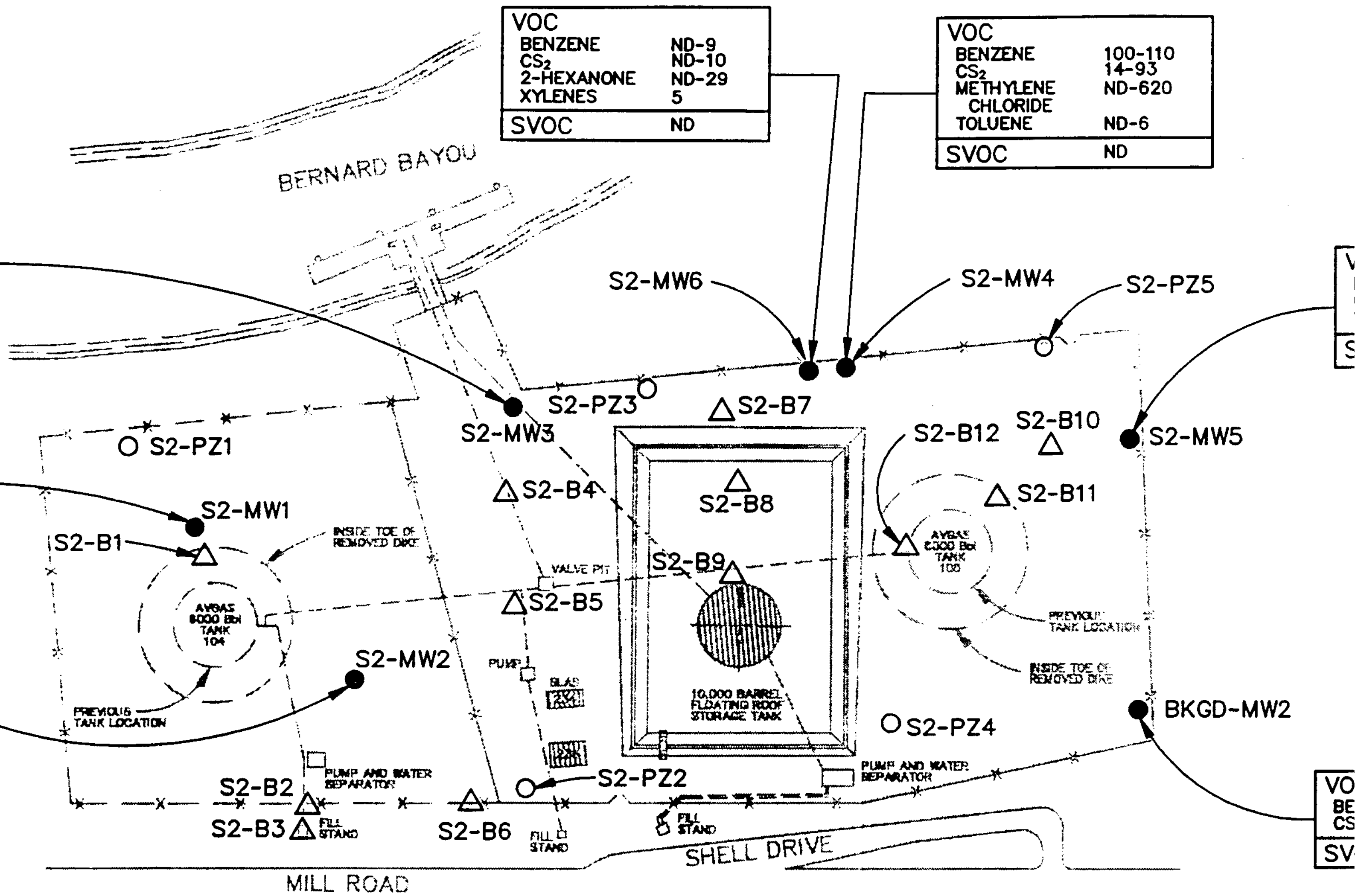

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ORGANIC COMPOUNDS IN GROUNDV
GULFPORT FIEL
Gul

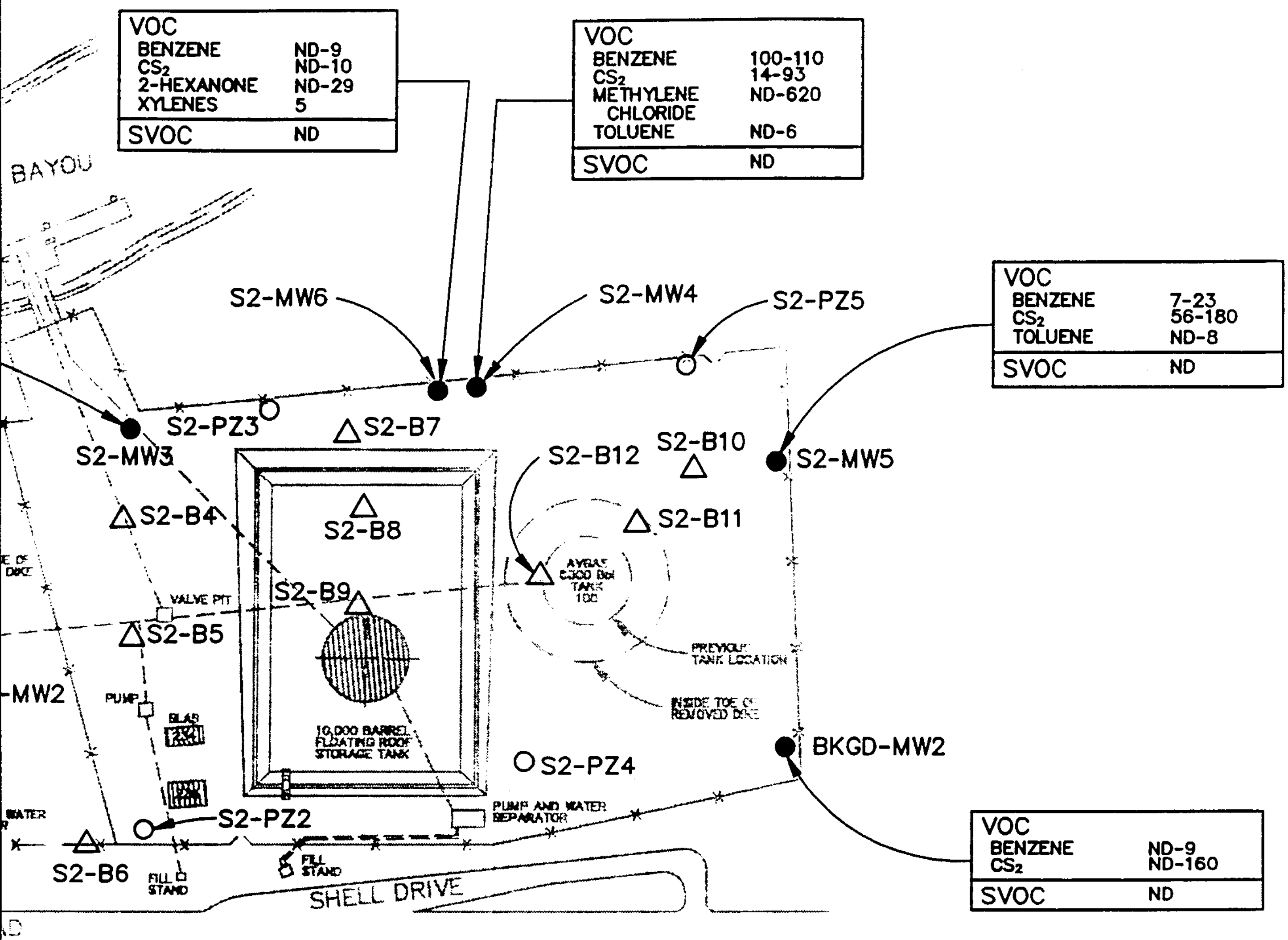

FIGURE 3.14
ORGANIC COMPOUNDS IN GROUNDWATER AT SITE 2
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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Five VOCs (benzene, ethylbenzene, EDB, toluene, and total xylenes) that are indicative of residual fuel and/or solvent contamination were detected above the CLP CRDL. Benzene also was detected in the site-specific background well at 9 μg/L (concentration greater than the MCL of 5 μg/L), and this concentration was exceeded or equalled in eight of the 13 groundwater samples analyzed at Site 2. EDB was detected (six samples) at up to 0.65 μg/L, ethylbenzene (four samples) at up to 110 μg/L, toluene (three samples) at up to 19 μg/L, and total xylenes (six samples) at up to 300 μg/L. EDB exceeded the MCL of 0.05 μg/L. None of these compounds were detected above the CLP CRDL in the site-specific background groundwater samples.

Due to the concentrations of VOCs detected in groundwater samples at Site 2, S2-MW6 was installed to check for the presence of floating hydrocarbons. No floating hydrocarbons were detected in S2-MW6.

3.5 SITE 3: MOTOR POOL ABOVE-GROUND DIESEL FUEL STORAGE TANK AREA

A 5,000 gallon above-ground fuel storage tank used by the motor pool since 1954 contained MOGAS until 1981 and then diesel fuel until the present. Visually stained soils indicate some spillage and based on the PA, an estimated 3,400 gallons of MOGAS and diesel may have been released at this site.

3.5.1 Field Investigation

As summarized in Table 2.2, samples were collected from soil borings and monitoring wells at Site 3 in May 1991 to assess the presence of organic and inorganic contaminants in soil and groundwater. Groundwater samples were collected again in June 1991. The locations of sample points at Site 3 are shown on Figure 3.15. All the samples were screened in the CSL (Level B), and selected samples were split and a portion analyzed in the analytical laboratory (Level C) for VOCs, SVOCs, and eight metals. Groundwater samples were analyzed for total and soluble metals.

Screening activities included:

- Advancing three hand-auger borings
- Installing and sampling three piezometers and measuring the water levels

The monitoring well location was selected based on an evaluation of the piezometer water level measurements. The well was sited on the downgradient side of the tank and as close as possible to the source area (contaminated soils). The potential source area soils were contained in the bermed area around the tank. Because of the complexity and abundance of underground utilities at this site, the placement of the monitoring well was restricted.

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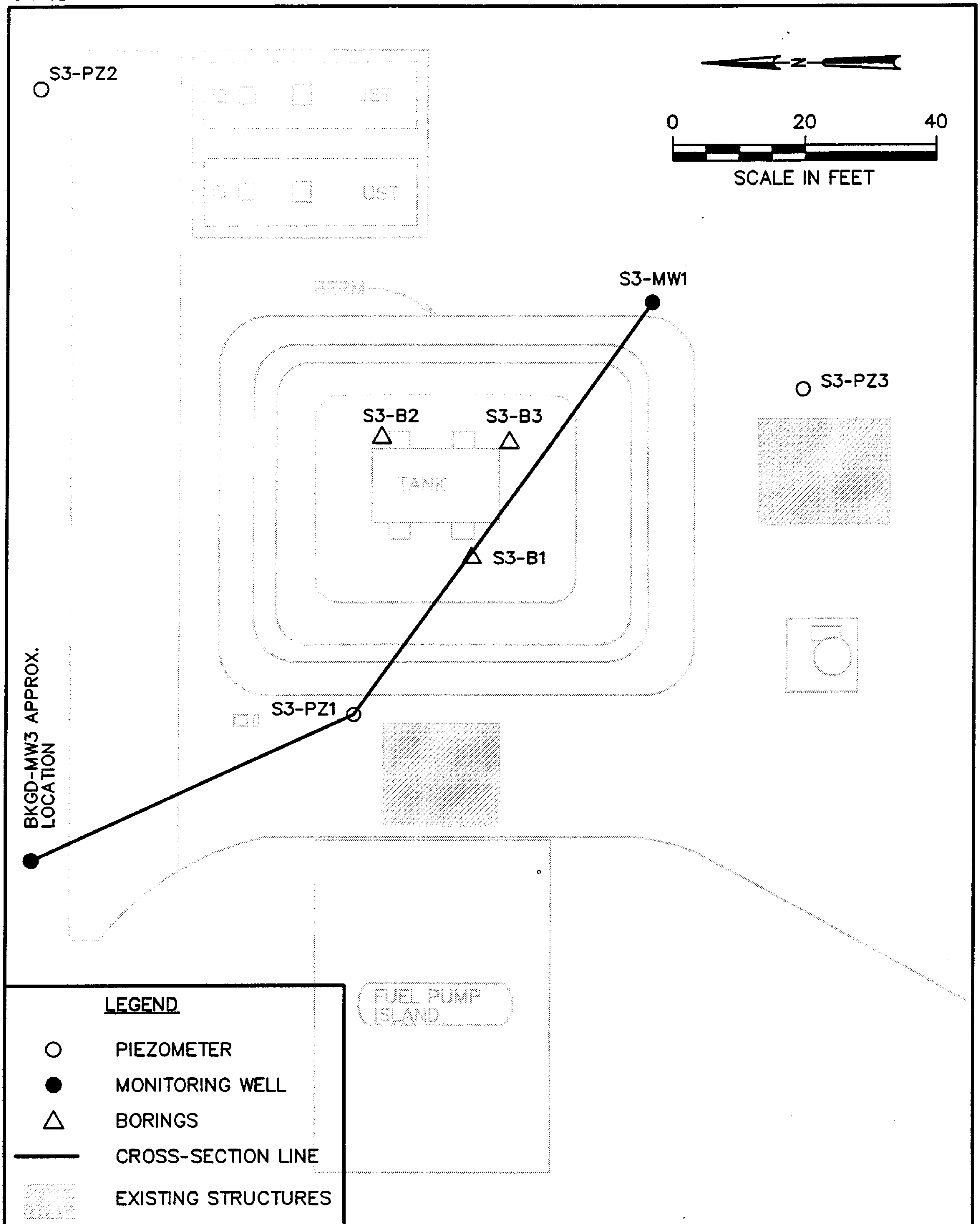

NOTE:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.15
SITE 3 SAMPLE LOCATION MAP
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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Figure 3.16 is a hydrogeologic cross-section prepared from the data collected at Site 3. The section shows that the subsurface materials are predominantly sand. The background well did encounter a clay bed at about 20 feet below grade, but the thickness of the clay bed is unknown. Water level measurements in the well and piezometers showed the water table to be consistently about 3 feet below grade. Field observations reported that after heavy rainfall, the water table was at or near land surface. This observation indicates rapid infiltration of rainfall.

Figure 3.17 shows the water table and resulting flow directions that were evaluated from groundwater elevation measurements taken from the piezometers. The figure shows that the water table has a slight gradient which slopes to the southeast. The background monitoring well, BKGD-MW3, location was selected on piezometer and monitoring well groundwater measurements. No optional monitoring wells were installed at this site.

A groundwater flow rate was estimated for this site using Darcy's Law (V=KI/n) and the following parameters:

I	=	Hydraulic gradient = 0.006 (unitless)
K	=	Hydraulic conductivity = 5.0 x 10^{-4} centimeters per second
n	=	0.25 (unitless)

Using the parameters above, the average linear velocity was about 12 feet per year.

3.5.2 Screening Results

The CSL soil and groundwater results are summarized in Appendix B. CSL results from hand-auger boring S3-B1 indicated the presence of residual fuel contaminants in the shallow soils at the 4 to 6 foot depth interval. The remaining five samples from the three soil borings were below method detection limit (BMDL) for each of the target analytes. The groundwater sample from piezometer S3-PZ2 indicated the presence of residual fuel contaminants; samples from the other two piezometers did not detect target analytes.

Water level measurements in the piezometers yielded a slight gradient with a tendency for groundwater flow direction towards the southeast. Location of the one confirmatory monitoring well was selected after evaluation of the apparent flow direction and chemical analyses of soil and groundwater samples from the borings and piezometers. The results of the chemical analyses are discussed in the following section. Locations of the soil samples are shown in Figure 3-18.

3.5.3 Confirmatory and Optional Results

The Level C analytical data for soil and groundwater samples at Site 3 are presented in Tables 3.7 and 3.8.

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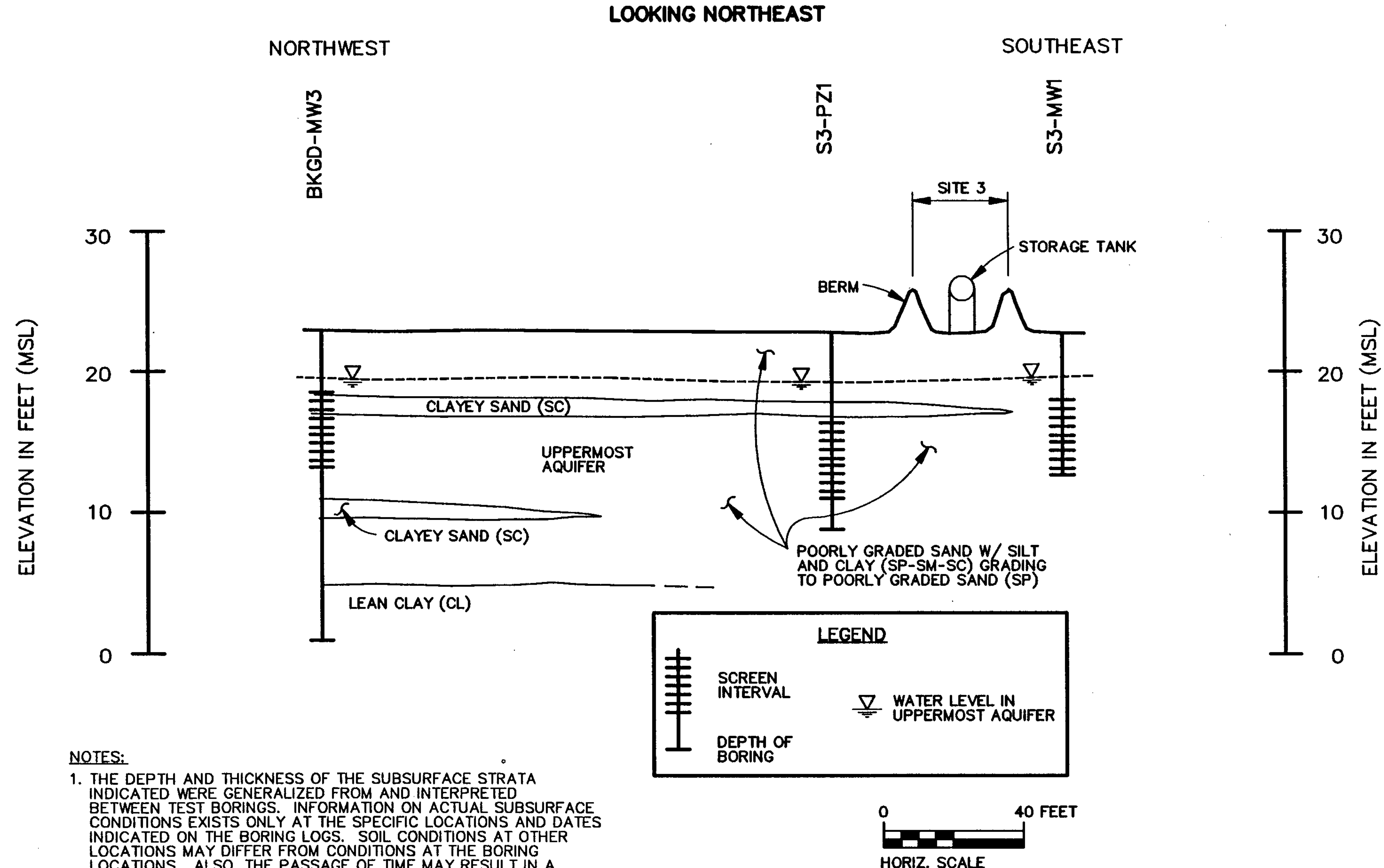

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED WERE GENERALIZED FROM AND INTERPRETED BETWEEN TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED ON THE BORING LOGS. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THESE CONDITIONS.
2. WATER LEVELS WERE MEASURED ON 6/17-18/91
3. MSL - MEAN SEA LEVEL

FIGURE 3.16
HYDROGEOLOGIC CROSS-SECTION THROUGH SITE 3
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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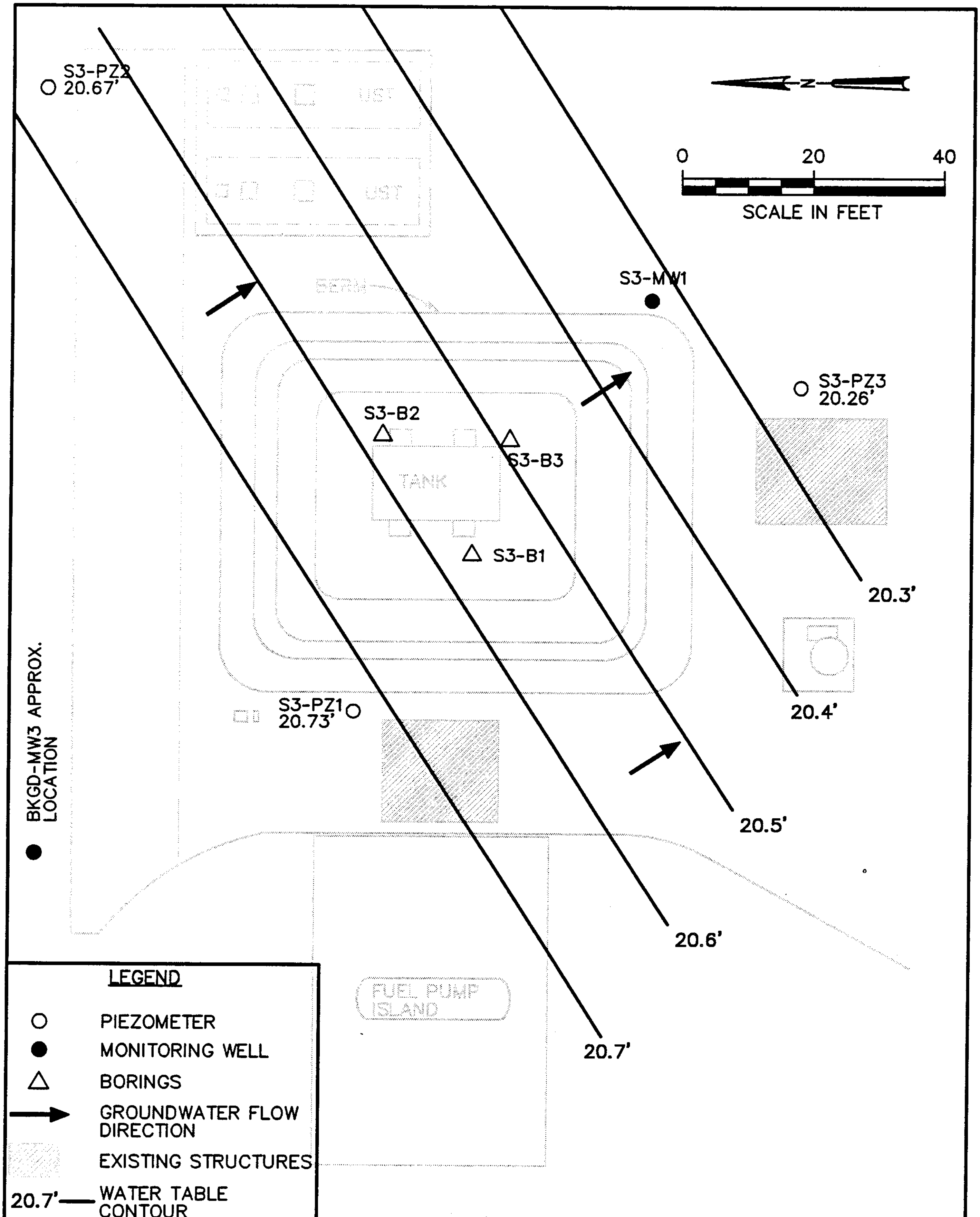

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.17
WATER TABLE MAP OF SITE 3
IN MAY 1991
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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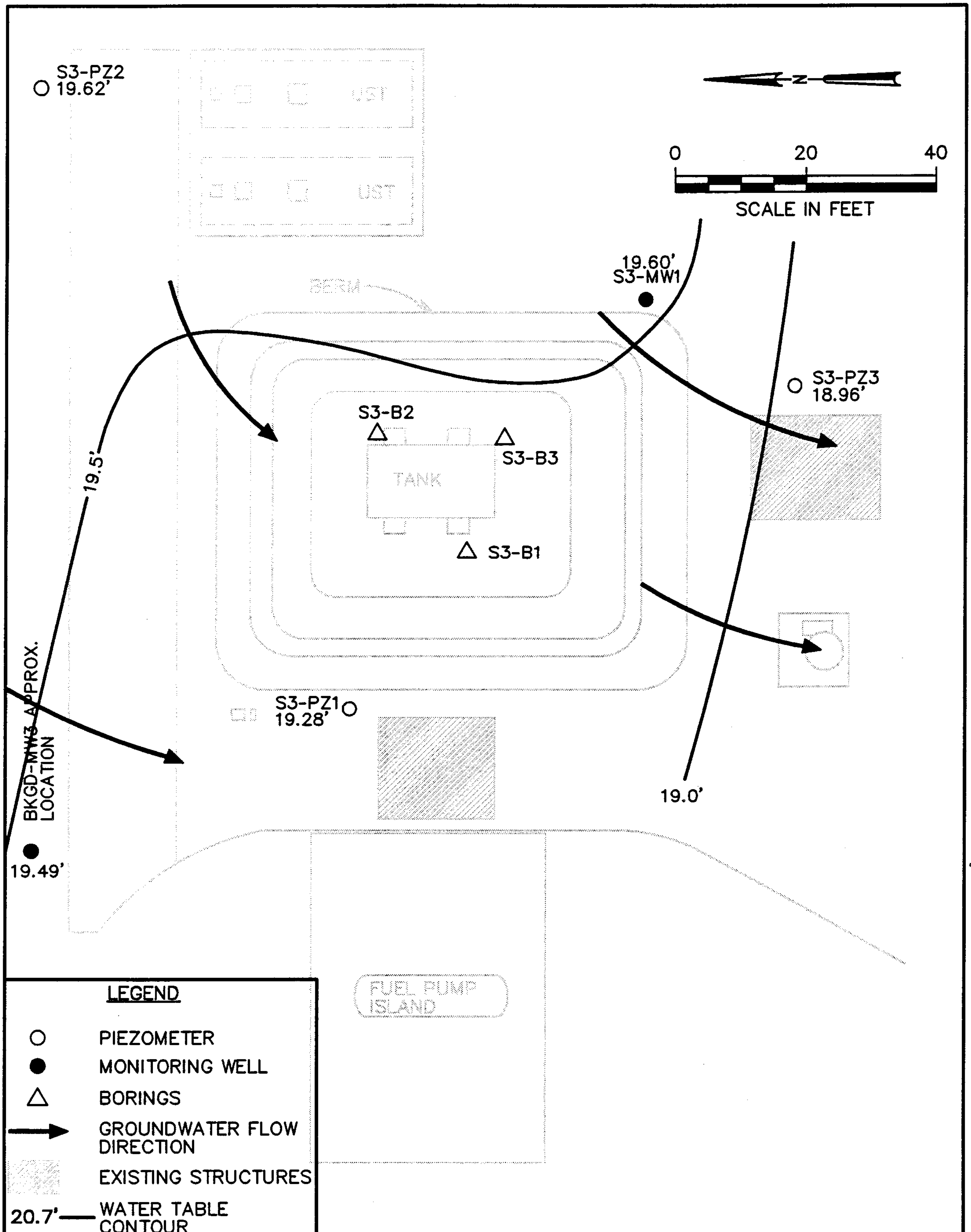

NOTES:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.18
WATER TABLE MAP OF SITE 3
IN SEPTEMBER 1991
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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Table 3.7
Site 3: Motor Pool Above-Ground Diesel Fuel Storage Tank Area
Soil Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	Maximum Background Concentration	S3-B1	S3-B2	S3-B3
			4-6 ft 5/01/91 soil 18463001	4-6 ft 5/01/91 soil 18463002	4-6 ft 5/01/91 soil 18463003
VOCs ethylbenzene (μg/kg)	5	ND	2,800		
total xylenes (μg/kg)	5	ND	34,000		
SVOCs 2-methylnaphthalene (μg/kg)	330	ND	2,100		
naphthalene (μg/kg)	330	ND	2,200		
METALS total chromium (mg/kg)	2	47.9	4.8	4.8	3.8
total lead (mg/kg)	0.6	36.8	27.8	9.5	15.9

Notes:
All soil detection limits do not include a correction for sample moisture.
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
ND: Not detected in the background sample above the CRDL.
CRDL: Contract required detection limit.
μg/kg: Micrograms per kilogram.
mg/kg: Milligrams per kilogram.

Table 3.8
Site 3: Motor Pool Above-Ground Diesel Fuel Storage Tank Area
Groundwater Sample Results
Gulfport Field Training Site, Gulfport, Mississippi

Analyte	CRDL	MCL	Maximum Background Concentration	S3-MW1 5/10/91 water 18539001	S3-MW1 5/10/91 water/dup 18539002	S3-MW1 6/19/91 water 18794006
VOCs						
carbon disulfide (μg/L)	5	--	160			11
SVOCs						
(none detected > CRDL)						
METALS						
soluble cadmium (μg/L)	3	5	ND		6.9	
total lead (μg/L)	3	50	36.8			10.5
soluble lead (μg/L)	3	50	5.0	5.2		4.1

Notes:
Eight digit number in sample description is the laboratory report reference.
Blanks indicate value reported less than CRDL.
CRDL: Contract required detection limit.
MCL: Maximum contaminant level.
--: No MCL finalized.
ND: Not detected in the background sample above the CRDL.
μg/L: Micrograms per liter.

3.5.3.1 Soil Results

At Site 3, chromium and lead were detected in the three soil samples; however, the concentrations detected were below the background soil sample concentrations of 47.9 and 36.8 mg/kg, respectively.

Acetone was detected in one sample above the CLP CRDL, and this compound is attributable to laboratory contamination. Additionally, three other target VOCs and two SVOCs were reported above background and CLP CRDL concentrations in the shallow soils (4 to 6 feet) from within the berm at Site 3. These compounds are indicative of residual fuel contamination. The highest VOC and SVOC concentrations were for total xylenes at 34,000 μg/kg and naphthalene at 2,200 μg/kg, respectively.

3.5.3.2 Groundwater Results

Figure 3.19 shows the water table as mapped from water level measurements taken in September 1991. These measurements and contours result in a south-southwesterly groundwater flow direction. These results indicate that, at least for part of the year, the monitoring well, S3-MW1, is not downgradient of the site.

Lead was detected at 10.5 μg/L in one of the groundwater samples from the monitoring well at Site 3, and for only the June sampling round, in the unfiltered samples. This concentration was less than the background maximum of 36.8 μg/L of lead. Soluble cadmium and soluble lead were detected in the filtered samples and associated duplicate sample at up to 6.9 and 5.2 μg/L, respectively. Both of these concentrations are about equal to the filtered background concentration of 5 μg/L. Carbon disulfide was detected in one sample at 11 μg/L and can be attributed to the result of natural biodegradation processes. No other VOCs or SVOCs were detected above the CLP CRDL in the groundwater samples analyzed from the monitoring well at Site 3.

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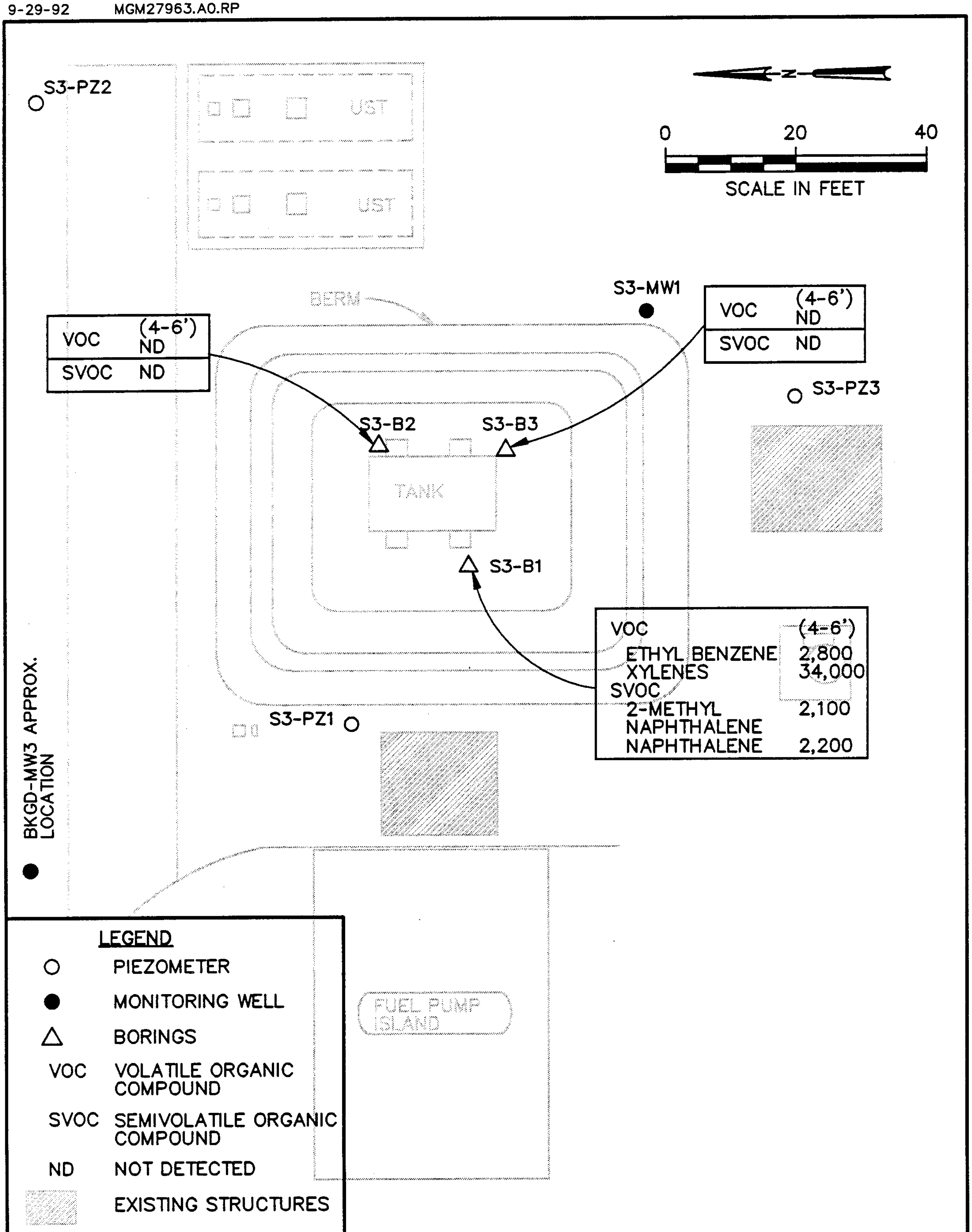

NOTE:
1. THIS MAP WAS COMPILED FROM FIELD SURVEYS AND EXISTING MAPS.
2. ALL CONCENTRATIONS REPORTED IN µg/kg (ppb).

FIGURE 3-19
ORGANIC COMPOUNDS IN SOIL AT SITE 3
GULFPORT FIELD TRAINING SITE
Gulfport, Mississippi

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4. PRELIMINARY RISK EVALUATION

The purpose of the PRE for the Base is to support recommendations for one of the following:

- Prepare a DD stating that no further action is required at the site
- Conducting an FFS/RM
- Conducting an RI/FS
- Immediate response (imminent threat)
- Source removal

The PRE is divided into five sections:

- Identification of the chemicals of potential concern at the Base
- Exposure assessment
- Preliminary human health risk characterization
- Preliminary ecological evaluation
- Summary and conclusions

4.1 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Field samples of soil, groundwater, and surface water were collected from the FTA (Site 1), the JP-4 bulk storage area on Mill Road (Site 2), and the above-ground diesel storage tank area at the motor pool (Site 3). Samples of soil and groundwater also were collected from three background locations at the Base. The samples were analyzed as described in previous sections for a specific set of compounds (target compounds) that included VOCs, SVOCs, and eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Target compounds were evaluated in this PRE if measured at concentrations greater than the CRDL. The common laboratory contaminants (bis(2-ethylhexyl)phthalate and other phthalate esters, methylene chloride, 2-butanone, acetone) were not evaluated in the PRE. These contaminants were not measured in field samples at concentrations greater than 10 times the concentration found in any blank sample. Therefore, detection of the common laboratory contaminants probably was the result of field sampling methods or inadvertent contamination in the laboratory.

The chemicals of concern detected in the groundwater, soils, or surface water at the Base are listed in Table 4.1.

4.2 EXPOSURE ASSESSMENT

For the purpose of evaluating human health risks and ecological hazards, exposure is defined as the contact of humans or other animals (receptors) with a chemical in the soil, groundwater, surface water, or air. Exposure to chemical contamination from the Base may occur if:

Table 4.1
Chemicals of Concern at the Base
Gulfport Field Training Site, Gulfport, Mississippi

Site	Groundwater	Soils	Surface water
1	Benzene Carbon disulfide Toluene Total xylenes Barium Cadmium Chromium Lead Silver	Benzene Ethylbenzene Fluoranthene 2-Methylnaphthalene Naphthalene Total xylenes Cadmium Chromium Lead	Carbon disulfide Cadmium Lead
2	Benzene Ethylene dibromide Carbon disulfide Ethylbenzene Toluene Total xylenes Lead	Benzene Ethylbenzene Toluene Total xylenes Phenanthrene Fluoranthene Pyrene Barium Cadmium Chromium Lead	N/A*
3	Carbon disulfide Cadmium Lead	Ethylbenzene Naphthalene 2-Methylnaphthalene Total xylenes Chromium Lead	N/A*

Chemicals were included on this table if measured at concentrations greater than the CRDL.

*N/A: Surface water samples were not collected at Site 2 or Site 3.

- A receptor comes into direct contact or ingests contaminated soils
- Chemicals of concern migrate from the site in air, surface water, or groundwater to an exposure point at which a receptor may inhale, ingest, or come into direct contact with the contaminated air or water
- Chemicals are bioaccumulated in the terrestrial or aquatic food webs upon which the receptors feed

An exposure pathway is a conceptual model of the means by which receptors could be exposed to the chemicals of concern. An exposure pathway is considered complete, and therefore should be evaluated, if there are all of the following:

- A source of contamination
- A mechanism for the release of contaminants
- An environmental transport medium (e.g., air, groundwater, surface water)
- An exposure point (a location at which a receptor could come into contact with contaminants at a concentration reasonably expected to cause adverse health effects)
- A route of exposure (inhalation, ingestion, skin contact)

Exposure will not occur if an exposure pathway is not complete. For example, if a clay confining layer prevents a chemical from leaching through soil into groundwater, then groundwater users will not be exposed to that chemical. In this example, the chemical cannot enter the environmental transport medium to which receptors might be exposed, so an exposure point does not exist.

Human and ecological receptors may be exposed to contaminants originating on the Base sites through various pathways. Because the pathways and risk evaluation procedures are not identical, the human health risk characterization and the preliminary ecological evaluation are discussed separately in Sections 4.3 and 4.4.

4.3 PRELIMINARY HUMAN HEALTH RISK CHARACTERIZATION

4.3.1 Potential Human Receptors and Exposure Pathways

The potential human receptors associated with the Base are Base personnel, offsite residents of the area around the Base, and potential future residents of land now under Base control. Because this was a preliminary evaluation, no attempt was made to locate sensitive subpopulations of receptors such as children in schools or daycares, elderly residents of nursing homes, or hospital patients.

Base personnel and potential future residents are the groups most likely to be exposed to contaminants at the three sites under evaluation. Exposure of potential future residents was considered at each site for this PRE. Site 1 is on Base property and Site 3 is located on property rented from the Airport Authority. It is likely that Sites 1 and 3 will remain part of the airport complex; therefore, exposure will be limited to base personnel. However, the area surrounding Site 2 may be developed as a residential area. Base personnel (Sites 1 and 3) and potential future residents (Site 2) might be exposed by oral ingestion of the chemicals detected in the groundwater at Sites 1, 2, or 3 if a drinking water well was installed in the shallow aquifer. Base personnel (Sites 1 and 3) and potential future residents (Site 2) might be exposed to the chemicals detected in the soils at Sites 1, 2, or 3 through incidental ingestion of soils, direct contact with soils, or inhalation of airborne dust.

Access to the Base (Sites 1 and 3) is restricted; therefore, offsite residents probably will not be exposed to the soils on Base, although infrequent exposure might occur to airborne dust. Offsite residents, however, might be exposed to the chemicals detected in the groundwater at Sites 1, 2, or 3 if the chemicals were to migrate offsite to domestic or municipal water supply wells.

Although there is a 6-foot chain-link fence surrounding the above-ground storage tank at Site 2, there are no physical barriers to prevent local residents from gaining access to the northwest corner. About one-third of Site 2 is currently being marketed for residential development.

Potential future residents of Sites 1, 2, or 3 might be exposed to the chemicals detected in the groundwater if the chemicals were to reach water that would supply the domestic needs of future residents and if the chemicals remained there unchanged in form or concentration. Potential future residents of the area at Sites 1, 2, or 3 might be exposed to chemicals detected in the soils by incidental ingestion, direct contact, or inhalation of airborne dust if the land is developed for residential use. Over time, however, degradation and transport would be expected to alter the location and concentrations of these chemicals. Furthermore, construction activities, grading, and excavating would be expected to alter chemical location and concentration. Therefore, the potential health risks to future residents cannot be meaningfully evaluated.

4.3.2 Summary of Exposure Pathways

The pathway for exposure of Base personnel to the chemicals detected in the groundwater at the Base probably is not complete. The City of Gulfport supplies water for personal or domestic uses on the Base from wells completed 850 to 900 feet below grade. Several of these wells are within a mile of the Base, the closest of which is about 1,300 feet from Site 3. The Base operates one well that is for industrial use only and is completed at 400 feet below grade. During sustained periods of pumping, the wells may be downgradient of all three sites. Exposure of

Base personnel to chemicals detected in surface water, sediments, or soils is possible during routine maintenance activities or construction and grading.

Because access to the Base is restricted, the pathway of exposure of offsite residents to the chemicals detected in the surface water, sediments, or soils probably is not complete. Offsite residents might, however, be exposed to chemicals detected in the groundwater at the Base if those chemicals migrate to offsite domestic water supply wells.

If the Base is developed for residential use in the future, then wells may be completed onsite to provide water for domestic use. Many shallow (less than 100 feet deep) wells were identified near the three sites. It is possible that new wells, especially for landscape irrigation, will be installed in the uppermost aquifer.

Because this document is a preliminary risk evaluation, the inhalation route and the dermal route of exposure will not be evaluated. Neither ambient air monitoring nor air modeling were conducted. Evaluation of the dermal route requires assumptions about the bioavailability of chemicals in soil, which depends on the soil type, the structure of the chemical, the adsorptive properties of the soil, the body surface area exposed, the adherence of soil to skin, the amount of time that the soil is in contact with the skin, and the frequency and thoroughness of bathing. A substantial amount of uncertainty is inherent to all of these assumptions, which results in a substantial degree of uncertainty in estimating dermal absorption. Although inhalation and dermal exposure will not be evaluated in this report, both pathways may be important in a baseline risk assessment.

4.3.3 Human Health Risk Characterization

The risks to the health of Base personnel or future residents associated with the chemicals detected at the Base were evaluated based on the concentrations measured compared to the risk-based concentrations that result in a cancer risk range from 1×10^{-6} to 1×10^{-4}, or a hazard quotient (for noncancerous effects) of 1. A cancer risk of 1×10^{-6}, one in 1 million, indicates that in a population of 1 million people exposed to a given chemical, one extra case of cancer above the background rate or expected number of cancers in that population is likely to occur. In the United States the background rate of cancer is about 25 percent; thus, 250,000 people in a population of 1 million can expect to develop cancer at sometime in their lives. Therefore, should this population of 1 million be exposed to a chemical at a concentration that results in a cancer risk of 1×10^{-6}, 250,001 people would then be reasonably expected to develop cancer in their lifetimes. In a recent directive from the EPA Office of Solid Waste and Emergency Response, a cancer risk in the range of 1×10^{-4} or greater was suggested as the point at which remedial action was warranted (EPA 1991).

The hazard quotient for chemicals with noncancerous effects is based on a quantitative estimate of the toxicity of a chemical; this estimate is the reference dose (RfD).

The RfD is the dose of a chemical in units of milligrams of chemical per kilogram of body weight per day that is expected to be without adverse health effects for humans including sensitive groups (the young, aged, or infirm). To calculate the hazard quotient, an estimate of the daily intake of a chemical is divided by the RfD for that chemical. If the quotient is greater than 1, then adverse health effects are reasonably expected to occur.

The risk-based concentrations were calculated with residential exposure assumptions for soil ingestion and groundwater ingestion (Tables 4.2 and 4.3) and are likely, therefore, to be more conservative than risk-based concentrations calculated for an industrial exposure scenario. Risk-based concentrations for the chemicals of concern at the Base are listed in Tables 4.4 and 4.5.

The concentrations of the chemicals of concern detected in the groundwater at the Base also were compared to current and proposed MCLs to evaluate the health risk of developing a domestic water supply well on the Base should the property be rezoned for residential use. The concentration of metals in filtered and unfiltered groundwater samples was measured and both concentrations are compared to MCLs. Unfiltered samples of groundwater contain soluble metals and metals bound to particulate matter. Although unfiltered samples of groundwater generally are used to assess the risk of adverse health effects, filtering removes particulate matter; therefore, the concentration of a metal in filtered samples is probably a better indicator of the concentration that would be ingested from a domestic water supply.

4.3.3.1 Site 1

The chemicals of concern detected in the groundwater or surface water at Site 1 are listed in Table 4.1. The concentration of benzene exceeded the 1×10^{-4} cancer risk range and the current MCL of 5 μg/L. Carbon disulfide exceeded the concentration that yields a hazard quotient of 1 in one duplicate sample from one sampling round. Ethylbenzene, toluene, total xylenes, barium, chromium, and silver did not exceed the concentration that yields a hazard quotient of 1. Barium, chromium, and silver did not exceed the appropriate MCL. Cadmium (6.4 μg/L) slightly exceeded the MCL of 5 μg/L but was within the range of background concentrations measured at the Base. Risk-based concentrations are not available for lead, but the concentrations measured did not exceed the current MCL (50 μg/L) and were within the range of background concentrations measured. Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel or future residents to the groundwater at Site 1 might present a health risk.

The chemicals of concern detected in the soils at Site 1 are listed in Table 4.1. All organic compounds were measured at concentrations below the concentrations that yield a cancer risk of 1×10^{-6} or a hazard quotient of 1. Cadmium, chromium, and silver were detected below the concentration that yields a hazard quotient of 1. A risk-based concentration is not available for lead, but the concentration measured at Site 1 is within the range of background concentrations measured. Therefore, based

Table 4.2
Exposure Factors for the Estimation of Exposure by Soil Ingestion*

Exposure Factors	Noncarcinogens	Carcinogens
Intake Rate	200 mg of soil/day for 6 years, 100 mg/day for 24 years	200 mg of soil/day for 6 years, 100 mg/day for 24 years
Exposure Frequency	350 days/year	350 days/year
Exposure Duration	30 years	70 years
Body Weight	15 kg for 6 years, 70 kg for 24 years	15 kg for 6 years, 70 kg for 24 years
Averaging Time	30 years x 365 days	70 years x 365 days

Source: EPA Region 10, *Supplemental Risk Assessment Guidance for Superfund*, August 16, 1991

*Exposure factors are based on a residential exposure scenario.

Table 4.3
Exposure Factors for the Estimation of Exposure by Ingestion of Groundwater*

Exposure Factors	Noncarcinogens	Carcinogens
Intake Rate	2 L of water/day	2 L of water/day
Exposure Frequency	350 days/year	350 days/year
Exposure Duration	30 years	70 years
Body Weight	70 kg	70 kg
Averaging Time	30 years x 365 days	70 years x 365 days

Source: EPA Region 10, *Supplemental Risk Assessment Guidance for Superfund*, August 16, 1991.

*Exposure factors are based on a residential exposure scenario.

Table 4.4
Risk-based Concentrations for Ingestion of Chemicals Detected in Soil Samples*

Chemical	Cancer Risk of 1 x 10^{-6}	Cancer Risk of 1 x 10^{-4}	Hazard Quotient of 1
Arsenic	0.4 mg/kg	40 mg/kg	80 mg/kg
Barium	-	-	20,000 mg/kg
Benzene	20	2,000	-
Cadmium	-	-	300 mg/kg
Carbon disulfide	-	-	30,000 mg/kg
Chromium (VI)	-	-	1,000 mg/kg
Ethylbenzene	-	-	30,000 mg/kg
Lead	-	-	-
2-Methylnaphthalene	-	-	-
Naphthalene	-	-	1,000 mg/kg
PAHs	0.06 mg/kg	6 mg/kg	-
Silver	-	-	800 mg/kg
Trichloroethene	60 mg/kg	6,000 mg/kg	-
Total xylenes	-	-	500,000 mg/kg

Source: EPA Region 10, *Supplemental Risk Assessment Guidance for Superfund*, August 16, 1991.

*Risk-based concentrations were calculated using residential exposure assumptions (Table 1).

Table 4.5
Risk-based Concentrations for Ingestion of Chemicals Detected in Groundwater Samples*

Chemical	Cancer Risk of 1 x 10^{-6}	Cancer Risk of 1 x 10^{-4}	Hazard Quotient of 1
Barium	-	-	3,000 µ/L
Benzene	0.6 µg/L	60 µg/L	-
Cadmium	-	-	20
Carbon disulfide	-	-	30
Chromium	-	-	200 (VI) 40,000 (III)
Ethylbenzene	-	-	2000
Ethylene dibromide	0.001	0.1	-
Lead	-	-	-
Silver	-	-	100
Toluene	-	-	3,000
Xylenes	-	-	800

Source: EPA Region 10, *Supplemental Risk Assessment Guidance for Superfund*, August 16, 1991.

* Risk-based concentrations were calculated using residential exposure assumptions (Table 1).

on a comparison of the concentrations measured (Section 3) to risk-based concentrations (Tables 4.4 and 4.5), exposure of Base personnel or future residents to the soils at Site 1 is not expected to present a significant health risk.

4.3.3.2 Site 2

The chemicals detected in the groundwater at Site 2 are listed in Table 4.1. EDB and benzene were present at concentrations that exceed the 1 x 10^{-4} cancer risk level and the appropriate MCLs. Carbon disulfide exceeded the concentration that yields a hazard quotient of 1. Ethylbenzene, toluene, and total xylenes were present at concentrations below the appropriate MCLs and that would yield a hazard quotient of 1. The concentration of lead was within the range of background concentrations, and all filtered samples were below the lead MCL (50 μg/L). One unfiltered sample contained lead at a concentration of 51 μg/L. Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel or future residents to the groundwater at Site 2 might present a health risk.

The chemicals detected in the soils at Site 2 are listed in Table 4.1. The concentrations of all chemicals except lead were within the 1 x 10^{-6} to 1 x 10^{-4} cancer risk range or below the concentration that yields a hazard quotient of 1. The concentration of lead was within the range of background concentrations. Therefore, based on a comparison of the concentrations measured (Section 3) to risk-based concentrations (Table 4.4), exposure of Base personnel or future residents to the soils at Site 2 is not expected to present a significant health risk.

4.3.3.3 Site 3

The chemicals detected in the groundwater at Site 3 are listed in Table 4.1. Lead did not exceed the MCL nor the range of background concentrations measured. Soluble cadmium (6.9 μg/L) slightly exceeded the MCL (5 μg/L) but was within the range of background concentrations. Therefore, based on a comparison of the concentrations measured (Section 3) to risk-based concentrations (Table 4.5), exposure of Base personnel or future residents to the groundwater at Site 3 is not expected to present a significant health risk.

The chemicals detected in the soils at Site 3 are listed in Table 4.1. Chloromethane was present at a concentration within the 1 x 10^{-6} to 1 x 10^{-4} cancer risk range. Ethylbenzene, total xylenes, and chromium were below the concentration that yields a hazard quotient of 1. Naphthalene and 2-methylnaphthalene exceeded the concentration that yields a hazard quotient of 1 in samples collected 4 feet below ground surface at one sampling location. These organic compounds are not expected to persist for a significant length of time. The concentration of lead was within the background range. Therefore, based on a comparison of the concentrations measured to risk-based concentrations (Table 4.4), exposure of Base personnel or future residents to the soils at Site 3 is not expected to present a significant health risk.

4.4 PRELIMINARY ECOLOGICAL EVALUATION

The main objective of this evaluation was to determine whether the chemicals present in water and soils at the Base are likely to cause adverse ecological effects. The data described earlier (see Section 3) were used to compare the concentrations in surface water and groundwater to the federal and state water quality criteria for protection of freshwater aquatic organisms (U.S. EPA, 1987; MDEQ, 1991) and to determine qualitatively whether bioaccumulation in the food chain might represent a hazard to vertebrate wildlife resources such as amphibians, reptiles, birds, and mammals.

As described in Sections 2 and 3, all samples were collected during a restricted period (May and June 1991). These data were used to assess current conditions at the facility and evaluate the probable effects on fish and wildlife resources in the vicinity of the three sites located at the Base.

A general description of each site was given in Section 1. The features that are most relevant to the ecological evaluation are (1) the location of Site 2 close to Bernard Bayou and wetlands that are contiguous to the bayou, and (2) surface water that is at least seasonally present within and near Site 1. Aquatic organisms such as fish and invertebrates were present in both areas and would be exposed to waterborne constituents that may affect them directly or be transferred to other animals that consume them. However, because samples of aquatic organisms were not collected for analysis, this interpretation is based on evaluation of literature sources in relation to concentrations measured in water.

Bernard Bayou is classified as Fish and Wildlife Waters by the State of Mississippi (MDEQ, 1991). Waters in this classification are intended for fishing and for propagation of fish, other aquatic life, and wildlife. Soils in the vicinity of the sites also could serve as an exposure medium for terrestrial invertebrates (e.g., earthworms) that could be consumed by vertebrate wildlife; thus, they also are of concern. Chemicals of potential concern were identified in Section 4.1. Those of greatest concern are the chemicals that may be toxic (acute and chronic effects) or bioaccumulated through the food chain.

4.4.1 Environmental Receptors

Aquatic and terrestrial fauna in the vicinity of the Base were not surveyed during the sampling period, so the potential environmental receptors near the site are not known in detail. However, on the basis of habitat information available on or near the site and communications with individuals familiar with the area, various kinds of receptors could be expected there. The following sections provide a brief description of fish, amphibians, reptiles, birds, and mammals that could occur on or near the site. In addition, the Mississippi Department of Wildlife, Fisheries, and Parks provided its Natural Heritage Program listing of special-status species known to occur within a 10-mile radius of the site or within Harrison County. Those species are summarized in Table 4.6, and the Natural Heritage Program lists are included as Appendix I.

Table 4.6
Mississippi Natural Heritage Program
Threatened and Endangered Species
Within a 10-Mile Radius of Gulfport
August 29, 1991

Common Name	Scientific Name	Global Rank	State Rank	Federal Status
		Plants		
Carolina Lilaeopsis	Lilaeopsis carolinensis	G3	S2S3	3C
Juneberry Holly	Ilex amelanchier	G3G4	S3	3C
A Hempweed	Mikania cordifolia	G5	S3S4	
Coast Sedge Large Beakrush	Carex exilis Rhynchospora macra	G5 G3G4	S1 S3	
A Bog Button	Lachnocaulon digynum	G3	S2	C2
Pine Barrens Prairie Clover	Petalostemon gracilis	G5T3T4	S2S3	
Southern Butterwort	Pinguicula primuliflora	G3G4	S3	
Stalked Adders-tongue	Ophioglossum petiolatum	G5	S2S4	
Large White Fringed Orchid Yellow Fringeless Orchid Giant Spiral Ladies' tresses	Platanthera blephariglottis Platanthera integra Spiranthes longilabris	G4G5 G3G4 G3	S2 S3S4 S2S3	 3C
Pan American Balsamscale	Elyonurus tripsacoides	G5?	SU	
Hooker's Milkwort	Polygala hookeri	G3G4	S1S2	
Incised Groovebur	Agrimonia incisa	G3	S1S3	C2
Coastal Plain False-foxglove	Agalinis aphylla	G3G4	S2S4	
Drummond's Yellow-eyed Grass	Xyris drummondii Xyris chapmanii	G3 G?	S2 S?	C2

Table 4.6 (Continued)
Mississippi Natural Heritage Program
Threatened and Endangered Species
Within a 10-Mile Radius of Gulfport
August 29, 1991

Common Name	Scientific Name	Global Rank	State Rank	Federal Status
Animals				
American Alligator	Alligator mississippiensis	G5	S4	T/SA
Osprey Bald Eagle	Pandion haliaetus Haliaeetus leucocephalus	G5 G3	S4 S1	 LELT
Atlantic sturgeon	Acipenser oxyrhynchus	G3	S1	
Spiny-tailed crayfish Lavender burrowing crayfish	Procambarus fitzpatricki Fallicambarus byersi	G2 G3?	S2 S3	
Scarlet Kingsnake Gulf Salt Marsh Snake Pine Woods Snake	Lampropeltis triangulum elapsoides Nerodia fasciata clarkii Rhandinaea flavilata	G5T5 G5T4 G4	S4 S2S3 S3?	
Ironcolor shiner Coastal shiner	Notropis chalybaeus Notropis petersoni	G5 G5	S4? S4?	
Chicken Turtle Diamondback Terrapin	Deirochelys reticularia Malaclemys terrapin	G5 G5	S4 S3	
Red-cockaded Woodpecker	Picoides borealis	G2	S2	LE
Dusky Gopher Frog	Rana areolata sevosa	G5T2	S1	C2
Coal Skink	Eumeces anthracinus	G5	S4	
Bewick's Wren	Thryomanes bewickii	G5	S2S3	

Notes:

G2 Imperiled globally because of extreme rarity or because of some factors making it especially vulnerable to extinction.

G3 Either very rare and local throughout its range or found locally (even abundantly in some locations) in a restricted range.

Table 4.6 (Continued)
Mississippi Natural Heritage Program
Threatened and Endangered Species
Within a 10-Mile Radius of Gulfport
August 29, 1991

G4	Apparently secure globally, though possibly rare in some parts of the range, especially at the periphery.
G5	Demonstrably secure globally, though possibly rare in some parts of the range, especially at the periphery.
S1	Critically impaired in the state because of extreme rarity or because of some factors making it especially vulnerable to extinction.
S2	Imperiled in the state because of rarity or because of some factor(s) making it especially vulnerable to extinction.
S3	Rare or uncommon within the state.
S4	Apparently secure within the state.
T/SA	Threatened/accidental in the state, including species documented very few times or at very great intervals.
C2	Category 2 - information insufficient to list; survey needed.
3C	Former candidate species, but proven to be more abundant and/or less threatened than originally believed.
LELT	Listed endangered/listed threatened.

G? or S? - Ranking uncertain at this time.

Among the most common animals expected to occur near the site, representative fish and wildlife species that are less mobile (at least seasonally and therefore might have the greatest exposure) are listed in Appendix J.

Water in Bernard Bayou near Site 2 varies in salinity from 0 to 10 parts per thousand (ppt), depending on season (L. Lewis, Mississippi Bureau of Marine Resources, personal communication). Thus, the local wetland fauna would include freshwater and estuarine species and also would vary somewhat seasonally. Surface drainages near Site 1 are less influenced by marine/estuarine waters, as judged from available maps, and probably have fauna more characteristic of freshwater environments. Marsh habitats in the vicinity of the Base include both fresh and brackish marshes. Terrestrial habitats in the vicinity of the three sites include wooded areas (pines, etc.) and grassy open areas, as well as unvegetated bare soils and pavement.

4.4.1.1 Fish

Freshwater and estuarine fish species occur in Bernard Bayou near Site 2, and fish were observed within Site 1 during sample collection. Fish within Site 1 were probably freshwater species that reached the site by swimming upstream in the adjacent ditch (a tributary to Turkey Creek) and in overland flow that occurs during rainfall events. Although species were not identified in any of the habitats at the Base, an array of species probably is present in proximity to Sites 1 and 2. Those fish seen within Site 1 were small, making them potential prey for various kinds of fish-eating birds (particularly herons and egrets). Three special-status species of fish are listed by the Mississippi Natural Heritage Program as occurring within a 10-mile radius of the Base (Table 4.6), and those are the only ones listed as occurring within Harrison County (Appendix I). Fish such as the shiner species are considered the most likely to occur close to the two sites.

More common species of freshwater fish that could be expected to occur near Sites 1 and 2 include gar, catfish, mosquitofish, sunfish, largemouth bass, and crappies, as well as several other species (Appendix J). Estuarine/marine species that are at least seasonally present near Site 2 include spotted sea trout, red drum, mullet, killifish, anchovies, silversides, blue crabs, and penaeid shrimps (Christmas, 1973; L. Lewis and D. Ruple, Mississippi Bureau of Marine Resources, personal communication) Several of those species are popular among sport and recreational fishermen and could be caught near the sites, particularly Site 2. The fish fauna in this vicinity would be present for extended periods, during which they could be exposed to chemicals originating on the Base. The fish and crustaceans would consume a wide variety of nektonic and benthic aquatic organisms.

4.4.1.2 Amphibians and Reptiles

The herpetofauna of the vicinity includes salamanders, frogs, toads, turtles, lizards, snakes, and the American alligator (Appendix J). Snakes, turtles, and frogs typically constitute the greatest number of species of amphibians and reptiles in the region.

The highest concentration and greatest species diversity can be expected in dryer areas located near marshes and bayous. All species are permanent residents, although they may be seasonally inactive while hibernating. Eight special-status species are listed by the Mississippi Natural Heritage Program as occurring within a 10-mile radius (Table 4.6), and seven additional species are listed within Harrison County (Appendix I). Those within the 10-mile radius include the alligator, three snakes, two turtles, one frog, and one lizard.

Most of the herpetofauna are omnivorous or carnivorous. The amphibians and lizards feed primarily on invertebrates such as insects, worms, and spiders. Turtles feed largely on fish, invertebrates (e.g., crustaceans, mollusks, and insects), and vegetation. Snakes and alligators eat a wide variety of vertebrates (e.g., fish, frogs, salamanders, lizards, snakes, mammals, or birds and their eggs) and invertebrates (especially crustaceans and insects).

4.4.1.3 Birds

More species of birds (perhaps more than 200) than any other group of vertebrates can be expected to occur in the vicinity of the Base. These birds inhabit a wide array of habitats and differ greatly in their seasonal occurrence within the area. Some passerine species (such as titmice, nuthatches, gnatcatchers, waxwings, and warblers) inhabit the woodland canopies, where they feed primarily on insects. However, many of the bird species inhabit lakes, bayous, marshes, and nearby shorelines. These species include cormorants, coots, gallinules, rails, waterfowl, pelicans, gulls, terns, herons, egrets, and shorebirds (Appendix J). Some of these species (e.g., coots, gallinules, and certain waterfowl) feed primarily on vegetation, but most of them feed extensively on fish and other aquatic organisms, as well as terrestrial vertebrates and invertebrates. Gallinules, rails, herons, egrets, and some of the shorebirds, gulls, and terns nest in habitats similar to those found near the Base and are abundant during spring and summer. The mottled duck and wood duck also nest in the region, and large numbers of other waterfowl species (e.g., mallards, teals, and gadwalls) migrate to over-winter there. Certain birds of prey (e.g., hawks and owls) may be common throughout the year in some of the habitats found on or near the sites at the Base, feeding primarily on small mammals and other terrestrial vertebrates.

Four special-status species of birds are listed by the Natural Heritage Program within a 10-mile radius of the Base (Table 4.6), and 17 additional species are listed within Harrison County (Appendix I). Several of these bird species are likely to feed on fish and other aquatic organisms near Sites 1 and 2. Bald eagles nest within about 10 miles and may feed in Bernard Bayou (D. Ruple, personal communication). They are present during the winter (when they nest) but are absent during the summer. Ospreys are more common than eagles in the vicinity of Bernard Bayou, although they are not known to nest nearby. Cormorants also may feed in Bernard Bayou within proximity to Site 2.

The ospreys and eagles would feed on somewhat larger fish (e.g., mullet) than some of the other fish-eating birds (e.g., terns, herons, and egrets) that might feed in the immediate vicinity of Sites 1 and 2. The eagle's diet probably also includes birds (mainly waterfowl and coots) and mammals.

Least terns have been observed feeding within Bernard Bayou in the immediate vicinity of Site 2 (M. Wade, HAZWRAP, personal communication). They probably were birds from a nesting colony of several thousand that is located along the beach near Biloxi (D. Ruple, personal communication). Those terns feed heavily on anchovies and silversides from habitats such as Bernard Bayou. The terns are present in the region from mid-April to mid-August.

The other special-status birds (red-cockaded woodpecker and Bewick's wren) that may occur within a 10-mile radius feed primarily in woody vegetation or other habitats that make them less likely to receive significant exposure to contaminants at the Base.

4.4.1.4 Mammals

Mammals that could occur on or near the Base sites include bats, opossums, shrews, various mice, rats, armadillos, muskrats, nutrias, raccoons, rabbits, and squirrels (Appendix J). Except for some bats, the mammals are generally year-round residents in the region. Many species often occur in the vicinity of wetlands but use higher ground for their dens and nests.

These mammals include species that are primarily herbivorous (e.g., some mice, rats, muskrats, nutrias, rabbits, and squirrels), omnivorous (e.g., opossums, raccoons), or carnivorous/insectivorous (e.g., bats, shrews, armadillos).

No special-status mammal species is listed by the Natural Heritage Program as occurring within a 10-mile radius of the Base (Table 4.6), but three species are listed within Harrison County (Appendix I).

4.4.2 Exposure Assessment

Three primary pathways are considered to be the most realistic means by which fish and vertebrate wildlife resources could be exposed to contaminants present at the Base. These include surface water, groundwater (if it reaches the surface), and soils. Surface water and groundwater are treated equally here because (1) groundwater may mix with surface water at Sites 1 and 2, and (2) surface water samples were taken only at Site 1 (the FTA).

Concentrations of all organic chemicals were either well below the applicable water quality criteria (U.S. EPA, 1987; MDEQ, 1991), or criteria and no observed effect levels (NOEL) have not been established. Cadmium, chromium, lead, and silver occurred in surface water or groundwater at concentrations that greatly exceeded the

water quality criteria for prevention of acute or chronic toxicity to aquatic organisms (Table 4.7). It should be noted that water hardness was not measured in any of these samples. Because some of the criteria for these metals are water hardness-dependent, data from other surface drainages in Harrison County (which averaged about 5 mg/L) were used to calculate the federal criteria for the site. (State criteria are based on 50 mg/L hardness if water hardness is equal to or less than that value.)

Concentrations of all four metals at Site 1 in either surface water or groundwater--or both--exceeded the calculated criteria values, sometimes by orders of magnitude. At Site 2, only lead in the groundwater exceeded the calculated criterion, while at Site 3 both cadmium and lead exceeded the criterion. Thus, sensitive aquatic species could be affected adversely by these waters, if they became exposed to them. Likewise, the metals probably would bioaccumulate in fish and other aquatic organisms living in the water and could thereby become available to higher trophic level consumers (e.g., fish-eating birds).

Chemicals present in the soil could become available to terrestrial wildlife if they are bioaccumulated by soil-dwelling invertebrate prey (e.g., earthworms and beetles) or plants that subsequently are consumed by wildlife. A wide array of vertebrate wildlife could feed on such contaminated foods. Examples include some species of salamanders, frogs, toads, turtles, snakes, birds, and mammals. Those species that have small home ranges (i.e., are more sedentary) would be more likely to receive greater dietary exposure than animals that range over larger areas than are affected by the three sites.

Lead does not tend to bioaccumulate in earthworms, but a typical concentration factor of 21 has been found for cadmium in soils to earthworms (Beyer, 1990). Animals (e.g., robins) that feed extensively on earthworms may, however, receive substantial exposure to lead because of the quantities of soil they ingest with the worms (as their gut contents). Although lead is not accumulated readily by plants and translocated to other plant parts, cadmium may be accumulated through the roots and translocated to leaves (Eisler, 1985, 1986, 1988; Bodek et al., 1988). Chromium concentrates in plant roots and moves slowly to other plant parts. Thus, plant-eating wildlife species feeding near the contaminated sites may be exposed to those metals through their diet.

4.5 SUMMARY AND CONCLUSIONS

4.5.1 Human Receptors

Three potential receptor groups were identified for evaluation in the Base PRE: Base personnel, offsite residents, and future residents should the Base be developed for residential use. The potential exposure of these three groups to the chemicals detected in samples of soil, groundwater, and surface water was evaluated based on reasonable and complete exposure pathways and the chemical concentrations measured. Because this is a screening level risk assessment, the exposure pathways

Table 4.7
Maximum Concentrations ($\mu g/L$) of Chemicals in Surface Water and Groundwater at the Base Sites in Relation to Water Quality Criteria/Standards of Fresh Water

	Site 1b[b]		Site 2[b]	Site 3[b]	Water Quality Criteria[c]			
					Federal[c]		State[d]	
Chemicals[a]	Surface	Ground	Ground	Ground	Acute	Chronic	Acute	Chronic
Cadmium (total)	6.4	5.1	-	-	0.13	0.11	1.8	0.66
Cadmium (soluble)	-	5.1	-	6.9	0.13	0.11	1.8	0.66
Chromium (total)	-	48	-	-	16[e]	11[e]	16[e]	11[e]
Lead (total)	47	44	51	10	1.80	0.07	34	1.3
Lead (soluble)	-	9	34	5	1.80	0.07	34	1.3
Silver	-	10	-	-	0.02	0.12	1.2	-

[a]Chemicals not listed are those for which there are no numerical criteria/standards and those for which concentrations were at least an order of magnitude below the criteria/standards. However, benzene concentrations in groundwater at Sites 1 and 2 were 5 to 10 times the limit for water from which fish consumption is considered safe.

[b]--indicates concentrations not measurable.

[c]Source: U.S. EPA, 1987. For those criteria that are water hardness-dependent, 5 mg/L was used in calculations.

[d]Source: MDEQ, 1991. All criteria that are water hardness-dependent are based on hardness of 50 mg/L if hardness is 50 mg/L or less.

[e]Values are for hexavalent chromium; comparable values for trivalent chromium are 150 and 18 $\mu g/L$ for federal criteria and 980 and 120 $\mu g/L$ for state criteria.

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evaluated were soil ingestion and ingestion of groundwater. Dermal absorption and inhalation of soil-borne contaminants were not evaluated although these might be important pathways for evaluation in a baseline risk assessment.

The risk of developing adverse health effects because of ingestion of contaminated soils or groundwater was evaluated by comparing the measured concentrations of chemicals to risk-based concentrations for a residential exposure scenario. A risk-based concentration is a value calculated to represent the concentration that poses a given level of risk should exposure occur. Thus, risk-based concentrations used to evaluate cancer risks represent the chemical concentration equivalent to a cancer risk of 1×10^{-6} to 1×10^{-4}; for noncancerous effects, the risk-based concentration represents a chemical concentration that yields a noncancer hazard quotient of 1 (the point at which further inquiry may be necessary).

For the Base, chemical concentrations that were within the 1×10^{-6} to 1×10^{-4} cancer risk range or below this range, or that were below a hazard quotient of 1, were not considered a risk to human health. Furthermore, chemicals measured in filtered groundwater samples that did not exceed the appropriate MCL were not considered a risk to human health.

Potential health risks also were evaluated based on site-specific information:

- Sites 1 and 3 are now and will continue to operate as part of the ANG activity and the municipal airport for the Gulfport, Mississippi, area.
- There are no plans for development of Sites 1 and 3 for residential use.
- Site 2 is located within a residential area and may be developed for residential use.
- Groundwater at Sites 1, 2, and 3 is not now a domestic or industrial water supply.

Benzene concentrations in the groundwater at Site 1, and benzene, EDB, and carbon disulfide concentrations in the groundwater at Site 2 exceeded the 1×10^{-6} to 1×10^{-4} cancer risk range or the appropriate MCL. The presence of these chemicals does not now present a health risk because the groundwater at Sites 1 and 2 is not a potable or industrial water supply. Over time the chemicals now present will degrade and be transported away from the site. Therefore, in the future the concentrations and forms of the chemicals detected probably will be significantly different than at present and the risk of adverse health effects to future residents cannot be evaluated easily. The groundwater at Site 3 does not now present a health risk and, on the basis of the monitoring data reported here will not present a health risk to future residents should the site be developed for residential use.

Except for naphthalene and 2-methylnaphthalene detected at Site 3, no chemical detected in the soils at Sites 1, 2, or 3 exceeded the 1×10^{-6} to 1×10^{-4} cancer risk range or a hazard quotient of 1. Therefore, exposure of Base personnel, offsite residents, or future residents is not expected to present a health risk.

4.5.2 Ecological Receptors

Chemicals present in water and soils at the Base may represent a hazard to less mobile fish and wildlife species. Some of those are listed by the Mississippi Natural Heritage Program as occurring within a 10-mile radius of the site. Metal concentrations in surface water and in groundwater exceeded the calculated criteria concentrations to prevent acute or chronic toxicity to fish and other aquatic organisms. Small fish were present within the FTA (Site 1) at the time of sample collection. Those fish as well as others in the nearby ditch and in Bernard Bayou could provide a route of exposure for fish-eating birds (e.g., herons, egrets, and terns) that may feed there. Additional sampling or study may be needed to answer the following unknowns:

- **Contaminant concentrations in surface waters near Site 2.** The present evaluation is based on what may be a worst-case scenario--the groundwater some distance from Bernard Bayou. However, surface water was present within the berm near the fuel tank at the time of sampling and such water apparently has been discharged through a valve to drain into the bayou.

- **Extent of groundwater seepage from Site 2 into Bernard Bayou.** The present assessment assumes that seepage occurs and that contaminant concentrations in nearby areas of the bayou may be similar to groundwater within the site.

- **Possible occurrence of oil sheens on surface waters on or near the Base.** Surface sheens were not observed during sample collection in May and June 1991. However, if they did occur they may contain petroleum products that are very toxic to wildlife, especially developing embryos. For example, less than 1 μl of oil may be toxic to a duck embryo if the oil is applied to the eggshell. This quantity of oil could be transferred readily to a duck's eggs if the female's feathers were exposed to oil while she was feeding in a contaminated area.

- **Concentrations of chemicals in food chain organisms that might be consumed by fish or wildlife.** Dietary exposure is usually of much greater significance to animals than the concentration of contaminants found in their drinking water or air. Thus, analysis of terrestrial and aquatic food chain organisms at the Base (especially Sites 1 and 2) may be warranted.

- **Appropriate water quality criteria concentrations for metals that are water hardness-dependent.** Criteria concentrations were calculated on the basis of data from several sites further inland and therefore may not be correct for the Base (but they should be approximate).

- **Most likely exposure pathways and environmental receptors for the site.** This assessment was conducted without visiting the site, so it is possible that specific information for that area would alter the general conclusions reached in the evaluation of available data.

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5. CONCLUSIONS AND RECOMMENDATIONS

The overall objective of the ANG IRP is to identify the potential environmental problem sites at all ANG installations and to provide timely remediation as required to protect public health and the environment from confirmed and quantified contamination associated with past hazardous waste and spill sites. The primary objectives of the SI at the Gulfport Field Training Site were to:

- Evaluate the presence of environmental contamination at the three sites identified in the PA
- Conduct limited quantification of the extent of contamination, if detected
- Estimate the potential risks the contamination posed to human health and the environment

The PRE is a qualitative means of estimating potential risks. The object of the PRE is to qualitatively estimate risks to human and environmental receptors from chemical substances identified during SI field activities.

The purpose of this section is to summarize the findings of the SI and to present recommendations for further activity.

5.1 SITE 1: FIRE TRAINING AREA

5.1.1 Summary

Site 1, the FTA, was used for fire training exercises from 1972 (suspected use since 1954) to 1988, when it was abandoned. The site is located west of Gulfport-Biloxi Regional Airport Runway 13-31 and near Taxiway I on land that is leased by the Base. Unknown types of waste fuels and oils were used during the fire training exercises. The FTA pit consists of a flat, unlined, open earthen area, that is slightly bermed, with a water depth of up to 18 inches. The pit contains the charred frame of an airplane. Subsurface soil, sediment, and groundwater samples were analyzed for parameters indicative of solvents, general fuel waste, and oils. Tables 5.1 and 5.2 present data concerning the organic contaminants and metals detected in soil, sediment, groundwater, and surface water at Site 1.

Soil borings were drilled to a depth of 6 feet and samples were collected at 0 to 2, 2 to 4, and 4 to 6 feet. Target organic compounds, including PAHs, ethylbenzene, and total xylenes were detected at or above the CLP CRDL in the soils at all depths, with the greatest concentrations indicated at the 0- to 2-foot depth interval. The greatest concentrations of benzene were found in the 2- to 4-foot depth interval. Fluoranthene and PAH were detected in ditch sediment samples collected from the

Table 5.1
Organic Contaminants and Metals Detected in Soil and Sediment at Site 1
Gulfport Field Training Site, Gulfport, Mississippi

		Criteria for Comparison			
			Cancer Risk		
Contaminants of Concern	Maximum Site Concentration	Maximum Background	10^{-6}	10^{-4}	Hazard Quotient of 1
Site 1 - Soil					
VOC					
benzene (mg/kg)	0.560	ND	20	2,000	NA
ethyl benzene (mg/kg)	4.400	ND	NA	NA	30,000
total xylenes (mg/kg)	56.000	ND	NA	NA	500,000
SVOC					
2-methyl naphthalene (mg/kg)	23.000	ND	NA	NA	NA
naphthalene (mg/kg)	8.600	ND	NA	NA	1,000
Metals					
cadmium (mg/kg)	5.8	11.8	NA	NA	300
chromium (mg/kg)	4.4	47.9	NA	NA	1,000
lead (mg/kg)	24.0	36.8	NA	NA	NA
Site 1 - Ditch Sediment					
SVOC					
fluoranthene (mg/kg)	0.680	ND	NA	NA	NA
Metals					
cadimum (mg/kg)	2.2	11.8	NA	NA	300
chromium (mg/kg)	9.7	47.9	NA	NA	1,000
lead (mg/kg)	12.3	36.8	NA	NA	NA

ND: Not detected.
NA: Not available.

Table 5.2
Organic Contaminants and Metals Detected in Groundwater and Surface Water at Site 1
Gulfport Field Training Site, Gulfport, Mississippi

		Criteria for Comparison								
				Cancer Risk			Water Quality Criteria			
							Federal		State	
Contaminants of Concern	Maximum Site Concentration	Maximum Background	MCL	10^{-6}	10^{-4}	Hazard Quotient of 1	Acute	Chronic	Acute	Chronic
Site 1 - Groundwater										
VOC										
benzene (μg/L)	470	9	5	0.6	60	NA	NA	NA	NA	NA
carbon disulfide (μg/L)	14	160	NA	NA	NA	30	NA	NA	NA	NA
toluene (μg/L)	8	5	1,000	NA	NA	3,000	NA	NA	NA	NA
total xylenes (μg/L)	33	ND	10,000	NA	NA	800	NA	NA	NA	NA
Metals										
total barium (μg/L)	245	ND	1,000	NA	NA	3,000	NA	NA	NA	NA
soluble barium (μg/L)	212	ND	1,000	NA	NA	3,000	NA	NA	NA	NA
total cadmium (μg/L)	5.1	6.6	5	NA	NA	20	0.13	0.11	1.8	0.66
soluble cadmium (μg/L)	5.1	ND	5	NA	NA	20	0.13	0.11	1.8	0.66
total chromium (μg/L)	48.3	88.0	100	NA	NA	200 (VI) 40,000 (III)	16 (VI) 150 (III)	11 (VI) 18 (III)	16 (VI) 980 (III)	11 (VI) 120 (III)
total lead (μg/L)	43.6	36.8	50	NA	NA	NA	1.8	0.07	34	1.3
soluble lead (μg/L)	9.4	ND	50	NA	NA	NA	1.8	0.07	34	1.3
total silver (μg/L)	10.5	ND	NA	NA	NA	100	0.02	0.12	1.2	
Site 1 - Surface Water										
VOC										
carbon disulfide (μg/L)	60	ND	NA	NA	NA	30	NA	NA	NA	NA
Metals										
total cadimum (μg/L)	6.4	ND	NA	NA	NA	20	0.13	0.11	1.8	0.66
total lead (μg/L)	46.6	ND	NA	NA	NA	NA	1.8	0.07	34.0	1.3

ND: Not detected. NA: Not available.

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0- to 6-inch depth interval but not in the 30- to 36-inch interval. Four target organic compounds indicative of residual fuel contamination (BTEX) were detected above the CLP CRDL in selected groundwater samples. Benzene was found in the greatest concentration at 470 μg/L.

Carbon disulfide was detected above the CLP CRDL in all monitoring well samples collected from the second round of sampling and in two surface water samples. The concentration of carbon disulfide was less than background (92 μg/L) in all of the groundwater samples that were collected from Site 1.

The soil and groundwater samples also were analyzed for eight metals. Cadmium, chromium, and lead were detected in the soil samples at concentrations greater than background concentrations. Barium (total), cadmium (soluble), chromium (total), lead (total and soluble), and silver (total) were detected in the selected groundwater samples above the CLP CRDL and also in concentrations greater than background concentrations. In general, metals were detected in both the filtered and unfiltered samples. Metals in unfiltered samples commonly originate from fine-grained aquifers. These results indicate that chromium and silver (detected only in the unfiltered samples) are probably adsorbed to particulate material and are not present in soluble form. However, barium, cadmium, and lead were detected in both filtered and unfiltered samples, and are therefore solubilized in the groundwater. Cadmium and lead were detected in the surface water samples at concentrations greater than those detected in background samples.

5.1.2 Recommendations

The results of the PRE concluded that the four target organic contaminants (benzene, carbon disulfide, toluene, and total xylenes) and five metals (barium, cadmium, chromium, lead, and silver) that were detected in the groundwater at Site 1 may pose a risk to human health and the environment. The concentrations of benzene exceeded the current MCL and 1×10^{-4} cancer risk; cadmium exceeded the current MCL; and carbon disulfide concentrations yielded a hazard quotient of 1. Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel, offsite residents, or future residents to the groundwater at Site 1 might present a health risk. Currently, the groundwater from this shallow aquifer does not constitute a risk to human health because there are no receptors; hence the exposure pathway is not completed. In the future, if this land is developed for residential or industrial purposes, it is unlikely that drinking water wells will be installed in this shallow aquifer.

No significant risk of environmental exposure to non-humans to inorganic chemicals was indicated because the concentrations of all inorganic chemicals present in the groundwater at Site 1 were below applicable EPA water quality criteria, or criteria and NOELs have not yet been established. Metals concentrations in surface water and in groundwater exceeded the calculated criteria concentrations to prevent acute or chronic toxicity to fish and other aquatic organisms. Small fish and turtles were

present within the FTA and adjacent ditch at the time of sample collection. These organisms and others in the adjacent ditch and in Bernard Bayou could provide a route of exposure for fish-eating birds that may feed at Site 1.

All six of the organic compounds (benzene, ethylbenzene, fluoranthene, 2-methylnaphthalene, naphthalene, and total xylenes) and three metals (cadmium, chromium, and lead) that were detected in the soil samples at Site 1 were measured at concentrations below that for either an assigned hazard quotient of 1, or 1×10^{-4} cancer risk. Based on a comparison of the concentrations measured to risk-based concentrations, exposure of Base personnel, offsite residents, or future residents to the soils at Site 1 is not expected to present a significant health risk. The metals concentrations in the soils may pose a threat to the environment because of the animals that feed extensively on earthworms and plant-eating wildlife species that may be exposed to those metals through their diet. However, the concentrations detected in the soils are less than background concentrations, therefore, the risk to environmental receptors does not appear to be greater than background conditions.

The results of the PRE indicate that the levels of contamination detected in the soil and groundwater may pose a risk to human health and the environment. Therefore, it is recommended that additional IRP activities be performed at Site 1. The need for remedial action at Site 1 will be decided during a later stage of the IRP.

Groundwater is the only media that had concentrations of contaminants exceeding comparison criteria. Therefore, RI activities should include the following:

- Evaluation of the horizontal and vertical extent of contamination
- Evaluation of receptors (precise location of shallow wells)
- Fate and transport modelling of contaminants in groundwater
- Base-line risk assessment

5.2 SITE 2: JP-4 BULK STORAGE AREA, MILL ROAD

5.2.1 Summary

Site 2, the JP-4 Bulk Storage Area, was used for the storage of AVGAS (1943 to 1974) and JP-4 (1973 to 1989) fuel in above-ground storage tanks. The facility is located on leased property between Bernard Bayou and Mill Road and housed two 25,000-gallon above-ground AVGAS tanks (removed) and one 440,000-gallon JP-4 above-ground tank (existing). Volumes of AVGAS and JP-4 contaminated water were routinely released at this site from tank cleaning operations. Additionally, unknown solvents and/or waste oils were known to have been stored at this site, and a 2,000-gallon AVGAS spill occurred in the mid-1960s. Subsurface soil and groundwater samples were analyzed for parameters indicative of solvent, general fuel waste, and oils. Tables 5.3 and 5.4 present data concerning the organic contaminants and metals detected in soil and groundwater at Site 2.

Table 5.3
Organic Contaminants and Metals Detected in Soil at Site 2
Gulfport Field Training Site, Gulfport, Mississippi

		Criteria for Comparison			
			Cancer Risk		
Contaminants of Concern	Maximum Site Concentration	Maximum Background	10^{-6}	10^{-4}	Hazard Quotient of 1
Site 2 - Soil					
VOC					
benzene (mg/kg)	0.042	ND	20	2,000	NA
ethyl benzene (mg/kg)	5.100	ND	NA	NA	30,000
toluene (mg/kg)	0.180	ND	NA	NA	NA
total xylenes (mg/kg)	11.000	ND	NA	NA	500,000
SVOC					
fluoranthene (mg/kg)	0.460	ND	NA	NA	NA
phenanthrene (mg/kg)	0.450	ND	NA	NA	NA
pyrene (mg/kg)	0.440	ND	NA	NA	NA
Metals					
barium (mg/kg)	50	ND	NA	NA	20,000
cadimum (mg/kg)	4.3	11.8	NA	NA	300
chromium (mg/kg)	15.0	47.9	NA	NA	1,000
lead (mg/kg)	153	36.8	NA	NA	NA

ND: Not detected.
NA: Not available.

Table 5.4
Organic Contaminants and Metals Detected in Groundwater at Site 2
Gulfport Field Training Site, Gulfport, Mississippi

		Criteria for Comparison								
				Cancer Risk			Water Quality Criteria			
							Federal		State	
Contaminants of Concern	Maximum Site Concentration	Maximum Background	MCL	10^{-6}	10^{-4}	Hazard Quotient of 1	Acute	Chronic	Acute	Chronic
Site 2 - Groundwater										
VOC										
benzene (μg/L)	200	9	5	0.6	60	NA	NA	NA	NA	NA
carbon disulfide (μg/L)	180	160	NA	NA	NA	30	NA	NA	NA	NA
ethyl benzene (μg/L)	110	ND	700	NA	NA	2,000	NA	NA	NA	NA
ethylene dibromide (μg/L)	0.65	ND	0.05	0.001	0.1	NA	NA	NA	NA	NA
toluene (μg/L)	19	ND	1,000	NA	NA	3,000	NA	NA	NA	NA
total xylenes (μg/L)	690	ND	10,000	NA	NA	800	NA	NA	NA	NA
Metals										
total lead (μg/L)	51.1	36.8	50	NA	NA	NA	1.8	0.07	34	1.3
soluble lead (μg/L)	34.0	5.0	50	NA	NA	NA	1.8	0.07	34	1.3

ND: Not detected.
NA: Not available.

Twelve soil borings were drilled to a depth of 6 feet and samples were collected at 2 to 4 and 4 to 6 feet. Target organic compounds, including PAHs, benzene, ethylbenzene, toluene, and total xylenes were detected above the CLP CRDL in the soil at both depths, with the greatest concentrations reported in the 2- to 4-foot depth interval samples. Five organic compounds indicative of residual fuel contamination (benzene, ethylbenzene, EDB, toluene, and total xylenes) were detected at or above the CLP CRDL in groundwater samples from S2-MW2 and S2-MW3. Only EDB was detected in S2-MW1.

Carbon disulfide was detected above the CLP CRDL in all but two of the groundwater samples collected at the site. Carbon disulfide was not detected in the background soil sample. The concentration of carbon disulfide was less than background (160 μg/L) in all of the groundwater samples, except for one (180 μg/L) that was collected from Site 2.

The soil and groundwater samples also were analyzed for eight metals. Barium, chromium, and lead were detected in the soil samples at concentrations greater than background concentrations. Lead was the only metal that was detected in the groundwater samples above the CLP CRDL, and two samples had lead concentrations that exceeded background concentrations. Lead was also detected in both total and soluble samples at up to 51.1 μg/L. Metals in unfiltered samples commonly originate from fine-grained aquifers. The presence of lead in both total and soluble form indicates that lead has been solubilized in the groundwater.

5.2.2 Recommendations

The results of the PRE concluded that the organic contaminants (benzene, carbon disulfide, EDB, ethylbenzene, toluene, and total xylenes) and lead that were detected in the groundwater at Site 2 may pose a risk to human health and the environment. The concentrations of EDB and benzene exceeded the current MCLs and 1 x 10^{-4} cancer risk level, and carbon disulfide concentrations yielded a hazard quotient of 1. Based on the comparison of the concentrations measured to risk-based concentrations and MCLs, exposure of Base personnel, offsite residents, or future residents to the groundwater at Site 2 might present a health risk. The groundwater from this shallow aquifer does not constitute a current risk to human health because there are no receptors, which renders the exposure pathway incomplete. In the future, if this land is developed for residential or industrial purposes, it is unlikely that drinking water wells will be installed in this shallow aquifer.

No significant risk of non-human environmental exposure to organic chemicals was indicated at Site 2 because the concentrations of all organic chemicals present in the groundwater at Site 2 were below applicable EPA water quality criteria, or criteria and NOELs have not been established. The lead concentrations in the groundwater exceeded the calculated criteria concentrations to prevent acute or chronic toxicity to fish and other aquatic organisms. Fish and turtles were observed within Bernard Bayou at the time of sample collection. Bioaccumulation of lead in these organisms

and others in Bernard Bayou could provide a route of exposure for fish-eating birds that may feed at Site 2.

All eight of the organic compounds (benzene, chloromethane, ethylbenzene, toluene, fluoranthene, phenanthrene, pyrene, and total xylenes) and four metals (barium, cadmium, chromium, and lead) detected in the soil samples at Site 2, excluding lead, were detected at concentrations below that for either an assigned hazard quotient of 1, or within the 1 x 10^{-6} to 1 x 10^{-4} cancer risk range. Based on a comparison of the concentrations measured to risk-based concentrations, exposure of Base personnel, offsite residents, or future residents to the soils at Site 2 is not expected to present a significant health risk. A risk-based concentration is not available for lead; however, background concentrations were similar. The metals concentrations in the soils may pose a threat to the environment because of the animals that feed extensively on organisms that live in soils; these species may be exposed to those metals through their diet.

The results of the PRE indicate that the levels of contamination detected in the soil and groundwater may pose a risk to human health and the environment. Additional sampling is recommended to evaluate surface waters near Site 2 for possible contamination, evaluate groundwater seepage from Site 2 into Bernard Bayou, and determine appropriate water quality criteria for metals that are water hardness-dependent. Therefore, it is recommended that additional activities be performed at Site 2.

5.3 SITE 3: MOTOR POOL ABOVE-GROUND DIESEL FUEL STORAGE TANK AREA

5.3.1 Summary

Site 3, the above-ground diesel fuel storage tank area, was used for the storage of MOGAS (1954 to 1981) and diesel (1981 to present) fuel in the 5,000-gallon above-ground storage tank at the site. The facility is located at the Base Motor Pool to the east of Building 68. Ground discolorations from spillage were observed within the bermed area surrounding the tank, and an estimated 3,400 gallons of MOGAS and diesel may have been released at this site over the operating history of this tank. Soil and groundwater samples were analyzed for parameters indicative of solvents, general fuel waste, and oils. Table 5.5 presents data concerning the organic contaminants and metals detected in soil and groundwater at Site 3.

Three hand auger soil borings were augered inside the tank berm to a depth of 6 feet, and samples were collected at the 4- to 6-foot depth interval. Target organic compounds indicative of residual fuel contamination, including PAHs, ethylbenzene, and total xylenes were detected above the CLP CRDL in the soil samples. No organic compounds were detected above the CLP CRDL in the groundwater samples.

Table 5.5
Organic Contaminants and Metals Detected in Soil and Groundwater at Site 3
Gulfport Field Training Site, Gulfport, Mississippi

		Criteria for Comparison								
							Water Quality Criteria			
				Cancer Risk			Federal		State	
Contaminants of Concern	Maximum Site Concentration	Maximum Background	MCL	10^{-6}	10^{-4}	Hazard Quotient of 1	Acute	Chronic	Acute	Chronic
Site 3 - Soil										
VOC										
ethyl benzene (mg/kg)	2.800	ND	NA	NA	NA	30,000	NA	NA	NA	NA
total xylenes (mg/kg)	34.000	ND	NA	NA	NA	500,000	NA	NA	NA	NA
SVOC										
2-methyl naphthalene (mg/kg)	2.100	ND	NA	NA	NA	NA	NA	NA	NA	NA
naphthalene (mg/kg)	2.200	ND	NA	NA	NA	1,000	NA	NA	NA	NA
Metals										
chromium (mg/kg)	4.8	47.9	NA	NA	NA	1,000 (IV)	NA	NA	NA	NA
lead (mg/kg)	27.8	36.8	NA	NA	NA	NA	NA	NA	NA	NA
Site 3 - Groundwater										
VOC										
carbon disulfide (mg/L)	11	ND	ND	NA	NA	30	NA	NA	NA	NA
Metals										
lead (μg/L)	10.5	36.8	50	NA	NA	NA	1.8	0.07	34	1.3
soluble lead (μg/L)	5.2	5.0	50	NA	NA	NA	1.8	0.07	34	1.3
soluble cadmium (μg/L)	6.9	ND	5	NA	NA	20	0.13	0.11	1.8	0.66

ND: Not detected.
NA: Not available.

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Carbon disulfide was detected above the CLP CRDL in the second groundwater sample collected at the site but at a concentration less than that detected in the background well. Carbon disulfide was not detected in any of the soil samples.

The soil and groundwater samples also were analyzed for eight metals. Chromium and lead were detected above the CLP CRDL in the soil samples at concentrations less than the maximum background concentrations. Lead and cadmium were the only metals that were detected in the groundwater samples above the CLP CRDL and in concentrations that equaled or slightly exceeded background concentrations. Lead was detected in the total and soluble samples. Cadmium was reported in one soluble sample only. Soluble metals commonly originate from fine-grained aquifers. The presence of lead in both filtered and unfiltered samples indicates that lead has been solubilized in the groundwater.

5.3.2 Recommendations

The results of the PRE indicate that the levels of contamination detected at Site 3 do not pose a risk to human health or the environment. Therefore, it is recommended that a DD be prepared for no further action at this site.

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